# PUBLIC UNDERSTANDINGS AND ATTITUDES OF GENETICALLY MODIFIED FOOD

MARIE E. PURTELL
THE OHIO STATE UNIVERSITY
DEPARTMENT OF HORTICULTURE AND CROP SCIENCE
AGRICULTURE HONORS PROJECT
WINTER 2001

CONTENTS

**ABSTRACT**

"Genetically modified food," to one person, it sounds like an interesting addition to their normal diet, but to the next person it may seem like a fancy name for poison. In today's society, public opinion is extremely unpredictable. The inconsistencies between scientific explanations of new discoveries and the media's presentation of the explanations result in public fear of technology, misinformed individuals, and the unpredictable public perceptions. The biotechnology industry has progressed very quickly, often leaving consumers in the dust. Through this study, I hope to begin to bridge the gap.

In order to determine specifically what fears, concerns and misconceptions about genetically modified food consumers hold, I conducted a series of four focus groups. During the focus group interviews, participants were asked a series of specific questions that I wrote to create a discussion that would reveal not only their concerns, but also their thought and feelings about genetically modified food.

Besides analyzing public comments within a group interview, I also conducted a literature review to identify actual problems that may develop from genetic engineering technology and what is being done to stop their progression. While more consumers were concerned with health related issues, the greater potential for real problems exist in environmental impacts, such as pest resistance and threat to non-target organisms.

## INTRODUCTION

"Genetically modified food," to one person, it sounds like an interesting addition to their normal diet, but to the next person it may seem like a fancy name for poison. In today's society, public opinion is extremely unpredictable. Regardless of whether public information originated from scientists trying to project a specific image or from a journalistic impression, the variable nature of a community's attitude on issues of science and technology is directly influenced by the manner in which the public was informed about the current circumstance (Tapestry, 2000). While scientists create new technologies and determine whether a particular product or condition may be harmful, the media decide how the information is presented. The inconsistencies between scientific explanations of new discoveries and the media's presentation of the explanations result in public fear of technology, misinformed individuals, and the unpredictable public perceptions.

As history proves, the public's recent criticisms toward science have merit. For example, the horror of the atomic bomb, chemical warfare, the depletion of the ozone layer and the "greenhouse effect," cancer-causing chemicals, and the exhaustion of fossil fuels all represent past failures to anticipate and control negative effects of scientific advances. These misfortunes justify the instigation of a more disparaging evaluation of advances in science and technology by the public. Science is no longer assumed to be innately good simply because it is based on logic (Ronzheimer, 1999).

Because the public has a more pessimistic attitude towards new advances in science and technology, more questions must be answered and addressed before new paradigms are accepted. Unfortunately, simply providing more information, performing

new tests, and analyzing new situations will not necessarily increase public understandings.

First, the scientific community has its own language of acronyms and technical terms unfamiliar to even scientists in different disciplines. For example, a computer scientist explains that a computer does not work by saying, "the motherboard's bus rate will not support the power requirement of the RAM chip," or a plant scientist describes a plant that needs watering by reporting, "the soil fails to have a water potential sufficiently more negative than that of the leaf cells." Unless a person is active in a specific field of study, sorting through the scientific jargon to find the actual meaning is near impossible. While understanding can be lost between two technically minded scientists, it is not surprising that clarity and comprehension can be abandoned in communication between scientist and journalist.

Secondly, the public wants absolute proof that the new product is harmless, or the invention will work and improve their standard of living; however, scientists are often unable to reply to the skepticism with a definite "yes" or "no" or "we're 100% sure." Many people do not understand and accept that laboratory conditions do not generate 100% accurate information; sometimes 83% is their best guess. The world is not a closed system and can introduce variables that are impossible to recreate in the highly controlled environment of a laboratory, disabling the possibility of 100% positive results. Also, many things about our existence are yet unexplained, even by science.

Another source of inconsistency within the reporting of scientific information is the limited amount of time scientists devote to public education. Especially within the academic community, scientists are too busy competing for grants and funding for

research and discussing new ideas among themselves to interact with the general public. (Koning, 1997) While this may seem to be a problem scientists can easily solve themselves, the truth is quite the opposite. In our industrialized society, scientific ideas have become a marketable commodity in a competitive market as a result of interventions from corporations, politicians, and the media. Public spending on research is declining as a result of this privatization of science; consequently, causing an increase in competition for research dollars and less time for public education. (Haerlin and Parr, 1999)

Besides decreasing public research in general, the privatization of science leads to the distrust of many scientist and engineers who work for private firms. Of course no one is going to believe the "expert" sent from the nuclear power plant, he or she was probably paid to promote his or her firm. Also, the public tends to favor those in opposition to science and technology because the opponents share the same fears as the public. As Ray describes, "In such a format, the opposition always "wins," because whoever is against any technology has only to make a charge, however preposterous, and doesn't have to prove it. That burden falls upon the supporter of science to prove that the charge is groundless (Ray and Guzzo, 1990)." Even the smartest of scientists would struggle to refute someone else's idea on the spot, especially if the idea did not flow from the logical school of scientific thought.

Aside from problems introduced by the scientists that contribute to public misunderstandings, the entire structure of the media system introduces a foundation for misconceptions. Even if a journalist were able to perform the seemingly impossible task of accurately translating scientific ideas into everyday language, the clearly understandable explanations would be deleted in editing the article to fit in a two-inch

column of a newspaper. Most scientific ideas cannot be accurately summarized in a 30-minute documentary; therefore, accomplishing this in a 30-second sound bite is unrealistic (Tapestry, 2000).

Finally, the public misconceptions about science can also be attributed to the public itself and society's general ignorance of simple scientific facts. Recent surveys of public scientific literacy in several major industrialized nations reported that the public lacks knowledge that the Earth revolves around the sun, or that antibiotics are ineffective against viruses (Ronzheimer, 1999). Public perception determines what products are purchased, what politicians are elected, what laws are passed, how global problems are solved, and is the core of a functioning society.

In this study, I will be analyzing public understandings and attitudes of genetically modified food by using focus group analysis. Through the open-ended response format of the focus group interview, I hope to obtain information describing respondents' concerns, opinions, and feelings about genetically modified food. In addition to hearing first hand the comments, reservations, and questions of actual consumers, I will be conducting an extensive literature review to evaluate misconceptions and identify absolute concerns. At the conclusion of this study, I plan to use all acquired data to develop an education program to promote the extinction of existing misconceptions.

## BACKGROUND

### Public Perception Summary

Past public opinion surveys indicate that Americans hold a wide range of opinions about genetically modified food. While some surveys indicate a highly negative public perception, others find positive results. Obviously, survey data is extremely sensitive according to how the questions are worded, how large of a sample was polled, what supplemental background information was provided, and possibly the agenda of the research team.

In the January 19,1999 issue, *Time Magazine* included responses to two questions within a report opposing genetically engineered food titled "Brave New Farm;" sample size was not indicated. The first question, "Should genetically engineered food be labeled as such?" where respondents agreed 82% yes and only 14% no. Secondly, "If food were labeled as genetically engineered, would you buy it for yourself or your family?" the consumers replied, 28% yes, 58% no (Consumers Union, 1999).

According to a press release on the results of a survey conducted by Novartis, Inc. in 1997, "Most Americans want foods that are genetically altered to be clearly identified with labels. 93% of Americans who responded to a recent survey by the world's largest agribusiness company agree that bioengineered food should be labeled as such, including 73% who strongly agree with the positions." Again, the sample size was not indicated (Consumers Union, 1999).

The International Food Information Council (IFIC) conducted a series of 1000 telephone interviews in March 1997, February 1999, October 1999, and May 2000. According to their report of all four surveys, at least 50% (the low of the 4 studies) of

consumers polled support FDA's current labeling requirements of genetically modified foods. The poll asked, "Some critics of the U.S. FDA policy say that any food produced through biotechnology should be labeled even if the food has the same safety and nutritional content as other foods. However, others, including the FDA, believe such a labeling requirement has no scientific basis, and would be costly and confusing to consumers. Are you more likely to agree with the labeling position of the FDA or with its critics? (IFIC, 2000)"

According to the National Food Processors Association, "A survey conducted of 1,000 U.S. adults in February 1999 by the Wirthlin Group found high awareness of food biotechnology, strong support for its benefits, and endorsement for current labeling requirements. The survey supports the fact that eight out of 10 Americans expect to derive benefits from biotechnology within the next five years (National Food Processors Association, 2000)."

In online poles, 26,179 people responded to CNN's poll question, "A study found bio-engineered corn can harm butterflies; should such crops be put on hold pending more study?" On May 24, 1999, 75% of the respondents agreed and 25% disagreed (Consumers Union, 1999). The online poll by the Environmental News Network of 826 people, asked respondents, "Will the benefits of genetically-modified food eventually outweigh its drawbacks?" On March 5, 2001, 54% had responded "yes" (Environmental News Network, 2000).

**Traditional Plant Breeding**

Through the domestication of plants and animals, humans have modified species over time by selecting individuals with desired traits and interbreeding them. As a result

of this process of artificial selection, most domesticated plants and animals bear little resemblance to their wild ancestors. For example, cauliflower, cabbage, Brussels sprouts, broccoli, kale, and kohlrabi all have a common ancestor in one species of wild mustard. By selecting different characteristics of the plant to accentuate, the flowers and stems of broccoli or the leaves of kale, breeders have obtained very different results. (Campbell, 1996) Even without modern biotechnology, today's crop plants have been genetically modified.

Although the initial development of crop plants from their wild relatives allowed for modern agricultural practices to take hold and created easier methods of growing food, the process of domesticating these plants eliminated advantageous characteristics sustained by wild plant populations maintained by natural selection. By artificially selecting plants that produce large amounts of fruits or other excellent agricultural characteristics, humans inadvertently created species of crop plants that lack excellent survival characteristics. While traditional breeding techniques allows for the development of hybrid varieties of crop plants that are a blend of the good characteristics from their parent varieties, developing new varieties that only inherit the advantageous characteristics is a lengthy and challenging process.

During traditional breeding, the entire genome or thousands of uncharacterized genes from the two parental plants are randomly mixed together, greatly reducing the probability that the offspring will inherit only the selected traits without any undesired traits passed along with them. For example, a plant breeder has two different varieties of corn, one that has excellent yield but does not tolerate dry soil conditions very well and another variety that has excellent drought tolerance yet does not produce very high yields.

Cross breeding these two varieties could produce a valuable hybrid that is both drought tolerant and high yielding; however, once the plant breeder has established both of the desired traits on a single offspring, they realize that their new hybrid has an unwanted trait has been accidentally added, susceptibility to lodging or stock breakage due to wind. Then, the breeder must backcross the offspring with previous crosses to eliminate the unwanted trait.

Following Sir Roland Biffen's 1905 discovery that wheat resistance to stem rust fungus was inherited, plant breeders wanting to develop pest-resistant strains of other crop plants soon encountered one of plant breeding by traditional methods' largest constraint-genes for a desired trait may not always be available in a sexually-compatible plant. In addition to this obstacle, often-desirable genes found on a sexually compatible plant may be linked unalterably to a different, undesirable trait such as a fruit with bitter taste (Smith, 2000).

In order to find beneficial new genetic traits to improve current varieties, plant breeders turn to wild forms of crop plants; however, not all modern day crops plants have sexually compatible wild forms. In fact, C. Wayne Smith writes in *Crop Production Evolution, History, and Technology*, "To date, no feral plant has been found having a reproductive structure remotely similar to the corn ear (Smith, 1995)."

With a constant need for improved crop plants to replace old strains that have lost their resistance due to adaptive pests, allow crops to be grown in differ field conditions, reduce inputs, and increase yields, plant breeders have been constantly looking for new technologies to increase the diversity of genes available for plant improvements.

**Biotechnology**

In the 19th century, Gregor Mendel discovered the basic principles of inheritance through his pioneering work with garden peas. By tracking heritable characteristics, Mendel was able to determine that alternative versions of a gene, one inherited from each parent, explain variations in inherited characteristics. Later scientists discovered that genes exist on chromosomes, identified the genetic material carrying the hereditary information as deoxyribonucleic acid or DNA, and finally, in 1953, James Watson and Francis Crick published the description of the double helical structure of DNA. In the early 1960s, scientists determined the method in which DNA controlled the building blocks of life (Campbell, 1996).

By serving as the blueprint for the construction of a protein, DNA controls all cellular processes responsible for life. DNA is composed of three parts, a five-carbon sugar (deoxyribose), a phosphate group linking the sugar components together, and one of four bases: adenine, guanine, thymine, and cytosine. These four bases are joined to the sugar-phosphate backbone in a precise, exact order called the genetic code that informs cellular machinery how to make a protein. Because all forms of life, from ants to plants, share this common genetic code and the required cellular machinery, it is possible to program one species to produce proteins characteristic of another species by transplanting DNA (Campbell, 1996).

In the development of bio-engineered plants, a researcher's first step in transferring DNA between species is to identify the segment of DNA, or gene, that carries the instructions for the protein of interest, enabling disease resistance for example.

Next, the gene is removed from the chain of DNA by using special enzymes that act like scissors to cut at a specific site along the DNA strand (Monsanto, 2001). After the gene of interest has been isolated, it can be introduced into plant cells by several gene-transfer methods. These methods include: electroporation, where plant tissues without cell walls, usually pollen grains, are exposed to pulses of a strong electric field causing small pores to appear in the plant cells that allow DNA from the surrounding solution to enter the cell (National Center of Biotechnology Education [NCBE], 2001); particle gun insertion, which fires microscopic pellets of gold, tungsten, or silver that are coated with DNA at plant cells, some of the treated cells take up the DNA from the metal pellets (Monsanto, 2001); microinjection, used in larger cells, DNA is directly injected with a fine glass needle (FEED Inc., 2000); and most successfully, the *Agrobacterium* method.

*Agrobacterium tumefaciens*, is a soil borne bacterium that causes crown gall, a disease that causes galls or tumors on the roots, stems and petioles of more than a hundred plant species. The bacteria do not invade plant cells but attach to the cell walls and insert their tumor-inducing plasmid, a small piece of circular DNA. Then, a piece of the bacterial plasmid transfers itself into the plant's DNA and transforms normal plant cells into tumor cells that grow and divide independently of the bacteria (Agrios, 1997). Plant researchers cut the tumor-inducing segment off of the *Agrobacterium* plasmid and replace it with foreign DNA containing beneficial genes. The new recombinant plasmid is reinserted into the bacterium, the bacterium inserts the DNA carrying the foreign gene into the plant cell, the plant cells are grown on culture or specially-formulated nutrient media, and finally the transgenic plant expressing the foreign gene is generated from the cultured cell (Tortora, 1998).

With all current transfer techniques, only a small proportion of the treated cells actually incorporate the foreign DNA. Therefore, additional marker genes are usually linked to the foreign DNA fragments before their transfer. These marker genes enable scientists to easily detect whether the desired gene has been inserted into the cell. At present, most marker genes introduce antibiotic or herbicide resistance that allows only the cells containing the marker gene to grow on specialized media (NCBE, 2001).

Another biotechnology tool commonly employed to improve crop plants is antisense technology. This technique allows scientists to "turn off" certain undesirable genes, such as genes that induce excessive softening of fruit, by inserting molecules of DNA or RNA (ribonucleic acid) that block the production of the proteins responsible for the undesirable trait (Campbell, 1996).

Unlike traditional breeding techniques, biotechnology permits the transfer of specific, well-characterized genes from the source organism to a target plant. Because the techniques are very precise and only insert the desired traits without any undesired trait linked to it, the time and cost required to develop improved varieties of crop plants decreases. However, regardless of the method in which the new desirable combination of genes were produced, the process of variety development is the same, requiring field testing at multiple locations over several years to assure performance and reveal unexpected weaknesses (Smith, 2000).

**The Commodities/Applications**

Applications of genetic engineering have already produced valuable products for human medicine. For example, human insulin, a small protein that controls the body's

uptake of glucose, produced by bioengineered bacteria replaced the use of less-effective animal insulin obtained from slaughtered animals (Tortora, 1998). Other biotechnology products with medical applications include a hepatitis B vaccine, interferon used to attack virus infections; tissue plasminogen activator for blood treatment, growth factors used in bone marrow transplants, and ELISA diagnostic tools (Smith, 2000).

Also, biotechnology has provided many uses in food processing. Cheese production is the result of an enzyme called rennin used to clot milk that is found naturally in the fourth stomach of milk-fed calves. Traditionally, the enzyme had to be extracted from the calves' stomach, but today the rennin is purified from a bacterium that has been genetically altered to produce it (Mangino, 2000). The rennin obtained by this method is structurally identical to the naturally occurring form. About 60 percent of the hard cheese produced in the United States is made with bacterially produced rennin (Smith, 2000).

In 1994, the FDA approved the first whole genetically engineered food product, the FlavrSavr tomato. In order for tomatoes to be available in the winter, they are picked green and stored. When ready for sale, they are exposed to ethylene gas, which causes ripening. Although the texture is similar to that of a vine ripened tomato, the flavor is highly inferior. Calgene Corporation, disabled the tomato's own gene by using antisense technology. Without the ability to produce an enzyme responsible for the breakdown of plant cell walls that causes softening of ripe tomatoes, the rate of softening in the FlavrSavr tomatoes was greatly decreased. This allowed for the tomatoes to be harvested when ripe and still firm enough to allow shipping for about a month (Mangino, 2000).

More recently, the use of genetically modified crops has increased substantially. From 1998 to 1999, total acreage devoted to biotech crops increased by 44 percent. In 1999, more than 99 million acres of modified crops were grown worldwide (Monsanto, 2001) with 70 million acres of bioengineered crops cultivated in the United States alone (FEED Inc., 2000). Also in 1999, genetically modified crops grown in the U.S. represented approximately 55 percent of all soybeans, 36 percent of all corn, and 43 percent of all cotton (FEED Inc., 2000). According to ISAAA (The International Service for the Acquisition of Agri-biotech Application), grower adoption of this new technology is the quickest adoption of a new agricultural technology ever recorded (James, 1999). The bulk of bioengineered crops last year comprised of corn modified to resist devastating fungus and Roundup Ready soybeans modified to resist a common herbicide (FEED Inc., 2000). As adoption rates indicate, genetically modified crops provide American farmers substantial savings (Smith, 15).

Today, nearly two-thirds of the products on American supermarket shelves contain genetically modified ingredients (FEED Inc., 2000). According to the FDA (Food and Drug Administration) and the USDA (United States Department of Agriculture), there are over 40 plant varieties that have completed all of the federal requirements for commercialization (Whitman, 2000).

For some crops, it is not cost-effective to remove weeds by physical means such as tilling, so farmers resort to spraying often-large amounts of chemical weed-killers called herbicides to destroy yield-suppressing weeds. Not only is this process expensive to the grower, but time-consuming as well because it requires special care to avoid herbicide damage to the crop plants or the environment. Soybeans and other plants have

been genetically modified to tolerate broad-spectrum herbicides. The most common is Roundup®-Ready soybeans, created by Monsanto; this variety can tolerate their herbicide product Roundup. Unlike many other herbicides, glyphosate, the active ingredient in Roundup, has a low toxicity and degrades quickly in the soil (Smith, 16). Besides soybeans, plants such as corn, canola, cotton, and sugar beets have been developed with herbicide tolerance to not only glyphosate, but also glufosinate (Liberty), produced by AgrEvo, and bromoxynil, produced by Rhone-Poulenc Rorer (UCS). In addition to reducing production cost and limiting the dangers of agricultural waste run-off, the use of herbicide-tolerant crops has reduced herbicide use and allowed farmers to adopt no-till farming practices that minimize soil erosion and moisture loss due to tillage (Smith, 2000).

Even more toxic to humans and the environment than herbicides are insecticides. These compounds not only degrade slower in the field, but they affect the nervous system of insects, creating a higher risk of human toxicity (Ohio State University Extension Bulletin, 1998). Biotechnology has decreased the use of these synthetic compounds by transferring genes from a naturally occurring soil bacterium, *Bacillus thuringiensis*, which produces proteins called delta-endotoxins that are only toxic to certain kinds of insect pests. Commonly used as a biological control agent, the *Bacillus thuringiensis* endotoxin now produced in "Bt" corn, allows the corn to ward off European corn borer, a pest that costs U.S. corn growers over $1 billion every year (Smith, 2000). Also, this technology enables Bt potatoes to resist Colorado potato beetle and Bt cotton to resist the pink boll worm (Smith, 2000).

Besides feeding damage, insects also transport disease-causing viruses from plant to plant. While normally controlled by insecticides, researchers are now able to prevent many types of viral infections without the use of chemicals through genetic protection. Similar to immunizations, plants can protect themselves from certain viruses though a mechanism known as cross-protection where plants are modified to produce viral coat proteins. Successful viral disease prevention has been incorporated into many plants such as potato, squash, cucumber, watermelon, and papaya (Smith, 2000).

In addition to pest and disease resistance, herbicide tolerance and reduced food costs, other traits of currently produced genetically modified crops include improvements for greater crop yield and quality, production of more desirable fats and oils, and enhanced shelf life and processing value (Hansen, 2000). Although not currently available on the market, rice has been genetically engineered to produce beta-carotene, a precursor to vitamin A. This product, known as Golden Rice, has been developed to prevent death and blindness in third world countries where impoverished people eat little besides rice to prevent these vitamin deficiencies (FEED Inc., 2000).

Beyond enhanced nutrition, future improvements from biotechnology may include: cold tolerance to prevent crop loss from unexpected frost, drought tolerance and salinity adaptations to allow food production in locations previously unsuited for plant cultivation, plant-produced pharmaceuticals such as edible vaccines to allow easier shipping, storage and distribution than current injectable vaccines, and possible applications in phytoremediation where plants could be used to clean up pollution (Whitman, 2000).

**U.S. Regulatory Framework**

Concerns about the potential dangers from recombinant DNA techniques first arose in the early 1970's. In 1974, the National Academy of Sciences convened a committee to recommend appropriate guidelines in response to voiced reservations from the scientific community about ethical and moral problems as well as the safety issues that might emanate from this technology. As this committee suggested, the director of the National Institute of Health (NIH) then established the NIH Recombinant DNA Advisory Committee to evaluate the hazards and develop guidelines for laboratory research using biotechnology. Within a few years, experience with recombinant DNA techniques had alleviated many fears. Because the NIH decided sufficient scientific knowledge regarding the safety of biotechnology was understood and many recombinant DNA experiments were not as hazardous as originally believed, the committee weakened many of these guidelines (Carpenter, 4).

In the early 1980's, risk issues surrounding genetic engineering changed with the proposed field testing of "ice minus" bacteria intended for use on a variety of crops to reduce the risk of freezing. At that time, the authority of NIH was questioned and the Office of Science and Technology Policy (OSTP) was formed under the White House Cabinet Council on Natural Resources and the Environment. Then, in 1986, the OSTP published the "Coordinated Framework for Regulation of Biotechnology," which established that new products developed through biotechnology would be regulated "in essentially the same manner for safety and efficacy as products obtained by other techniques" and would be regulated under authority granted under existing federal laws and regulations (Smith, 2000). The notice also determined which regulatory bodies were

designated as the lead agency where the possibility of duplication of oversight existed (Carpenter, 2001).

Since 1986, the regulation of agricultural biotechnology is controlled by: the United States Department of Agriculture (USDA), which is responsible for ensuring new crop varieties are safe to grow; the Environmental Protection Agency (EPA), which is responsible for making sure that new pest-resistant varieties are safe to grow and consume; and the Food and Drug Administration (FDA), who's responsibility is to ensure that new varieties are safe to consume (Carpenter, 2001). In addition, the Department of Labor's Occupational Safety and Health Administration was granted obligation for the safety and health of biotechnology workers and the NIH was to ensure laboratory safety of recombinant DNA research (Smith, 2000).

In 1992, the OSTP in association with the EPA, USDA, and FDA published The Statement on Scope that outlines the regulatory policy of each agency and established the main criteria for regulation of biotechnology products. According to this statement, oversight authority should be exercised only where there is evidence that the "risk posed by the introduction is unreasonable," and regulatory oversight "should focus on the characteristics and risks of the biotechnology product—not the process by which it was created (Smith, 2000)."

### 1. United States Department of Agriculture

"Under the Federal Plant Pest Act, USDA retains the authority to regulate plant pests and other articles to prevent direct or indirect injury, disease, or damage to plants, plant products, and crops (Carpenter, 2001)." After assuming the responsibility of

ensuring that genetically modified crops are safe to grow, USDA extended the regulation requirements imposed by their Animal and Plant Health Inspection Service (APHIS), which protects U.S. agriculture from pests and diseases, to included genetically engineered organisms. Not only was this distinction important to ensure, without question, that genetically modified organisms or products would fall under existing regulations of plant pests, but it also noted that APHIS was not treating genetically engineered organisms and products differently than non-genetically engineered organisms (Carpenter, 2001).

APHIS regulations provide procedures for obtaining a permit or for providing notification prior to importing, moving interstate, or releasing a "regulated article" in the United States (Smith, 20). According to APHIS, regulated articles are, "plants or microorganisms that are, or are believed to be, plant pests or are produced using plant pests (Smith, 2000)." A genetically engineered organism is deemed a regulated article either if the donor organism, recipient organism vector or vector agent used in engineering the organism is listed in the regulation and is also a plant pest, is unclassified, or if APHIS has reason to believe that the genetically engineered organism presents a plant pest risk (Carpenter, 2001).

Before a biotech product is field-tested, it is necessary for the developer or plant breeder to either obtain a permit or to notify APHIS. In 1993, APHIS introduced the notification option for specific field test plants that meet certain eligibility requirements and performance standards with which the department is familiar, provided that the introduction is conducted in accordance with established requirements and standards (Carpenter, 2001). As part of the notification procedure, APHIS then notifies the

department of agriculture in the state where the proposed field trials will be conducted (Smith, 2000).

To receive a permit, the plant breeder or developer must provide APHIS with information on how the plant was developed and what control measures will be taken during the trials, including field design, monitoring, and reporting requirements. Then the agency considers possible impacts, and a field test permit is issued if no significant chance of impact is determined (Smith, 2000).

Lack of plant pest risk may be concluded by APHIS when the following conditions are met: the plant exhibits no likely plant pathogenic properties; it is no more likely to become a weed than its non-engineered parental varieties; is unlikely to increase the weediness potential for any other cultivated plant of native wild species with which the organism can interbreed; does not damage to processed agricultural commodities; and is unlikely to harm other beneficial organisms (Carpenter, 2001).

Following several years of field tests, the plant breeder may file a petition for nonregulated status. Before a decision is reached, USDA requires data on the rationale for development, the environmental consequences of introduction, adverse consequences of introduction, the methods used to transform the genome, the donor genes and marker sequences used, and the genetic analysis and field performance. Aside from the required data, which is maintained in a public-accessible database, APHIS performs an environmental assessment according to the National Environmental Policy Act protocol (Smith, 2000). When a product is approved for full release, a Determination of Nonregulated Status is published in the Federal Register (Carpenter, 2001).

### 2. Environmental Protection Agency

Under the authority of the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA), the EPA regulates the distribution, sale, use and testing of plants and microbes producing pesticidal substances. Also, the EPA is required by the Federal Food, Drug and Cosmetics Act (FFDCA) to establish safe levels of pesticide residues in foods called tolerances. Additionally, tolerance levels must be set for residues of herbicides used on herbicide-tolerant crops. Non-pesticidal genetically engineered microorganism products are regulated under the Toxic Substances Control Act (TSCA) (Carpenter, 2001).

Before submitting an application for field-test approval and subsequent registration, a plant breeder or developer must first obtain an Experimental Use Permit (EUP) by consulting with the EPA scientific staff to decide upon the data requirements needed to support the application for registration. EPA registration requirements include data on product characterization, toxicology, effects on non-target organisms, exposure, and the chemical's fate in the environment. Product characterization data must include the source of the gene, how the gene is expressed, the nature of the pesticidal substance produced, modifications to the introduced trait as compared to the naturally occurring form, and the biology of the recipient plant. Toxicology analysis must determine the acute oral toxicity of the pesticidal substances when administered to mice, as well as determine digestibility time, and consider the allergenicity of the substance. For ecological effects, the EPA evaluates the degradation rates of the proteins in soil and plant residues, and examines exposure and toxicity of the plant-pesticide to non-target organisms (Smith, 2000).

While this is how the EPA currently regulates plant pesticides, in November 1994, the agency issued a new proposal detailing more specifically applicable to genetically modified organisms other than microbial pesticides and products. The proposed policy revealed the EPA's intent to regulate the pesticidal substances in plants, but not the plants themselves, leaving the regulation of the plants to USDA (Carpenter, 2001).

Through this new proposal several exemptions are proposed. Generic exemption from registration under FIFRA would be granted to plant pesticides derived through conventional breeding methods and plant pesticides that are derived from sexually compatible plants. Also viral coat proteins were also proposed to be exempt. Further, three categories of exemptions from tolerance setting under FFDCA were also proposed: plant pesticides that would not result in new dietary exposure, nucleic acids in plants, and coat proteins from plant viruses. With these exemptions, the EPA intends to regulate those plant-pesticides that have the greatest potential for adverse effects, on both the environment and on health (Carpenter, 2001).

In the 1994 proposed policy, the agency plans to consider the following risk issues for both field testing and sale or distribution of a plant pesticide: increased ability of the transgenic plant to survive outside cultivation; potential of gene capture and expression of the introduced trait by wild or weedy relatives; possibility of a trait introducing a selective advantage to a plant in a natural plant community and increasing the "weediness" of that species; environmental fate of the pesticidal substance, the dosage to soils after plant decay and incorporation into the soil, rate of degradation and transport in the environment; and finally whether or not the pesticidal substance is either

exuded or volatilized from the plant during the growing season (Carpenter, 2001). Currently, this new proposal is in the final stages of development (Smith, 2000).

**3. Food and Drug Administration**

Also under the Federal Food, Drug and Cosmetics Act (FFDCA), the Food and Drug Administration (FDA) regulates foods and food ingredients, including animal feed and feed additives. Foods produced through genetic engineering are subjected to the same safety standards as all non-biotech foods. In 1992, the FDA issued a policy statement establishing it's current regulatory framework with regard to foods developed using biotechnology. According to this policy, genetically engineered food regulation is considered under the food additive provisions of FFDCA that would require pre-market review and is interpreted to apply to the transferred genetic material and the intended expression product. Because nucleic acids are present in the cells of every living organism, the introduced genetic material itself is considered "generally recognized as safe" (GRAS). Expression products, such as proteins, carbohydrates, fat or oil, would only require pre-market review if they differ significantly in structure, function or composition from a substance found currently in food, or sufficient safety issues are raised (Carpenter, 2001).

Included in the 1992 policy statement are suggested guidelines to the industry for foods derived from new plant varieties. The guidance section contains a safety assessment of the new food, paying particular attention to changes in naturally-occurring or introduced toxicants and allergens, nutrient levels, and fat, oil, or modified carbohydrate contend, and the introduction of new substances. If significant alterations are found, formal FDA review and approval are required (Smith, 24). While voluntary

consultations with the agency has been standard practice for the food industry and the FDA knows of no food commercialized without consultation, these consultations have recently become mandatory as of May 2000 (Carpenter, 2001).

Because the FDA considers foods developed through biotechnology not significantly different from their conventional counterparts, genetically engineered foods do not require labeling. However, labeling is required for genetically modified foods that have altered nutritional characteristics or contain genetic material from foods that are commonly allergenic, unless it can be demonstrated that the allergenic property has not been transferred to the new plant variety (Carpenter, 2001).

## Non-Regulatory Framework

### The Responsibilities of the Plant Breeder

Besides private companies, State Agricultural Experiment Stations, USDA Agricultural Research Service stations, and Land Grant colleges and universities conduct plant-breeding programs. Once a product need is identified and the desired trait is available in one of the many genetic resources available, the new variety begins development. Apart from the method of trait incorporation, once the genetic transformation has been made, offspring of the plant are grown and observed. This development stage guarantees genetic stability by confirming the trait is permanent, predictable and maintains expression under a wide range of conditions. Other responsibilities of the plant breeder include determining reproductive stability, uniformity of traits, weediness, pest vulnerability, sensitivity to environmental stress, and if the variety contains risks of allergen or toxin introduction, the breeder must evaluate the food product (Smith, 2000).

Also, for seed crops eligible for protection under the Plant Variety Protection Act, the Association of Official Seed Certifying Agencies has a variety of established review boards that certify seed for protection. Besides, certification, some breeders register the release of the new variety in published journals, which may also provide non-regulatory oversight (Smith, 2000)

**Biotechnology in other countries**

In 1999, other countries that produced genetically modified crops included: Argentina with 6.7 million hectares (2.47 acres), Canada grew 4 million hectares, China had approximately 0.3 million hectares of production, and Australia and South Africa each grew 0.1 million hectares of genetically altered crops. Brazil, Mexico, Spain, France, Portugal, Rumania and Ukraine each produced less than 0.1 million hectares of bioengineered crops (James, 1999).

Unlike in the United States, other countries do not have strong pre-existing government organizations to regulate agriculture and agricultural products. Americans enjoy a food supply that is not only plentiful, but also widely recognized as among the safest in the world (Smith, 2000). While the U.S. government is only trying to eliminate possible oversights within its regulatory process to assess the special needs of biotechnology products, governments around the world are working to establish a regulatory process. However, different governments are responding in different ways depending on the political, social and economic situation within the country (Whitman, 2000).

In Japan, currently voluntary health testing of genetically modified foods will be mandatory as of April 2001 by the Ministry of Health and Welfare. Because no

genetically modified crops are grown in India and no biotech food products are available commercially, the government has not yet announced a policy on genetically engineered food. In Brazil, some states have banned genetically modified crops entirely, but Brazilian farmers are smuggling genetically modified soybean seeds into the country because they fear economic harm if they are unable to compete in the global marketplace with other grain-exporting countries (Whitman, 2000).

In the last few years Europe has experienced foods scares involving outbreaks of mad cow disease in Great Britain and dioxin-tainted foods originating from Belgium. These major food scares have eroded consumer confidence in the safety of their food supply, and consumers are reluctant to trust government information about genetically modified foods (Whitman, 2000). For at least two years, the European Union (EU) Commission on agriculture has been working on an approval and regulatory framework for use of genetically modified organisms in both cultivation and food processing. Food processors in the EU are required to perform mandatory DNA or other laboratory tests to determine the genetically modified food content of products, labels are required on products processed from genetically modified crops, and a threshold of one percent has been established for contamination of unmodified foods with genetically modified food products (Hanrahan, 1998; Whitman, 2000).

## PROBLEM ASSESMENT

### Health Risks

The health effects of food produced from genetically modified crops (sometimes called GM foods) depends on the specific content of the food itself and may have either potentially beneficial or occasionally harmful effects on human health. For example, rice with increased levels of vitamin A would have a positive effect on people whose diets are deficient in vitamin A (Gasson et al, 1999). On the other hand, there can be unexpected effects such as the introduction of allergens or increased levels of toxic plant compounds. Since all known food allergens are proteins, and introduced genes code for proteins, a possibility exists that an introduced gene could transfer an allergen to the genetically modified organism (Smith, 2000). Although voluntarily withdrawn from development by Pioneer Seeds, a Brazil nut protein was introduced into a soybean variety and a known allergen was conveyed to the transgenic organism (Hansen, 2000).

While true food allergies are quite rare and only affect 2 to 2.5 percent of the adult population, individuals with severe food allergies can experience an infrequent, yet potentially fatal, response to a food allergen called anaphylaxis (*July/August Food Insight*, 2000). A true allergy is a stimulated reaction of the immune system to a foreign molecule that is normally a glycoprotein (Mangino, 2000). Although normally outgrown, food allergies are more common in infants, affecting 4 to 6 percent of the population, and children, with an incidence in 1 to 2 percent of the population (*July/August Food Insight*, 2000). According to the International Food Information Council (IFIC), more than 90 percent of all food allergies in the United Sates are associated with the following foods:

cow's milk, eggs, peanuts, tree nuts, soybeans, and wheat in infants; and peanuts, crustacea (shrimp, crab, lobster, crawfish), tree nuts, and fish in adults (2000). In the creation of a new genetically modified organism, if genetic material from a food crop known to be allergenic is used in the creation of the new food, the resulting food is subjected to a high standard of proof of non-allergenicity. As outlined in FDA's Statement of Policy, a company developing a new plant-based food using genes from a know allergenic source must assume that this genetic material encodes an allergen unless they can conclusively prove otherwise (Smith, 2000).

Adverse responses to food not involving the immune system are considered food sensitivities. While not true allergies, food sensitivities, lactose intolerance for example, can produce symptoms similar to those of a food allergy. Food sensitivities are rarely life threatening and the symptoms are usually more localized (*July/August Food Insight*, 2000). The actual incidences of food sensitivities are unknown (Mangino, 2000).

While consumers may already be aware that foods may cause allergies, anti-GM food protestors often make a case for themselves by citing that there are a variety of toxic substances found in plants. These naturally occurring compounds presently exist in plants that we are already consuming. Some substances found in natural food can cause anti-nutritional effects, for example, the enzyme thiaminase, splits thiamin and makes it inactive as a vitamin. Also, oxalic acid, which is present in high quantities in spinach, rhubarb, tea and cocoa, binds to calcium and makes much of this mineral unavailable for absorbance by the body. Hemagglutinins, proteins that cause red blood cells to clump together, are present in high levels in legumes (peas, soybeans, and lentils) and can initiate a toxic response as well as cause reduced protein utilization. Most of the time,

cooking or processing removes natural plant toxicants. Cassava, which is a major food crop in some parts of the world, is specially processed to eliminate natural levels of cyanide, a poison, by grating the root to activate the poison releasing enzymes and then washing the grated root to remove the freed cyanide (Mangino, 2000).

Because there is a substantial amount of knowledge regarding potentially toxic compounds in plants, introduction of a gene from a plant known to contain toxins to a new plant would be extensively tested. FDA's Statement of Policy outlines a prudent scientific approach to minimize the risk of toxicant introduction in food crops (Smith, 2000). In order to reduce any possible risk due to potential increased levels of toxic plant compounds for any new crop plant, EPA, USDA, and FDA should create a coordinated database of information about natural plant toxicants to aid plant breeders and developers who might need to monitor these compounds in new plant varieties (National Academy of Sciences, 2001).

Although I understand that consumers might have concerns about genetic engineering introducing an allergen or toxin into food products, the risks are the same for plant varieties developed using biotechnology as those for similar varieties developed using classical breeding methods. In fact, testing for possible allergens in GM food has called the scientific community to reconsider the effectiveness of current tests for allergenicity. Controversy over the potential allergenicity of Cry9C endotoxin found in the Starlink® variety of Bt corn resulted in the GMO's disapproval for human consumption. Although the Cry9C insecticidal protein derived from *Bacillus thuringiensis* was not found to cause any food allergies, criticisms of the testing procedures for possible allergenicity delayed approval (Lewis and Kendall, 2000).

Unfortunately, what specifically makes a protein allergenic or what contributes to causing a protein to be allergenic is not known (Lewis and Kendall, 2000). Previously, guidelines used to evaluate potential allergens included: protein stability in the human gut, because food allergens typically are more stable than non-allergenic proteins; heat stability of the protein; the protein's amino acid sequence is compared to other know allergens; and the Brown Norway rat model of food allergy (Smith, 2000). The FIFRA Scientific Advisory Panel considering the issue of food allergenicity of Cry9C endotoxin and other non-digestible proteins considered most of these methods inadequate to accurately ensure no allergenicity and concluded more research is clearly needed (Lewis and Kendall, 2000). Finally, if a company were to bring a new food containing a known allergenic compound to market, current FDA policy would require labeling of the product (Smith, 2000).

In development of some genetically modified organisms, antibiotic resistance genes are used as "marker genes" to reveal that the new gene has been added by the plant cells. Since human health is maintained by the use of antibiotics to control disease-causing bacteria, there is increasing medical and public concern that antibiotic resistance genes used in biotechnology could transfer to pathogenic bacteria. While an extreme possibility a pathogenic bacteria could develop antibiotic resistance from a genetically modified plant actually exists, it is highly unlikely. First, antibiotic-resistance DNA would have to be expelled from the plant cell and remain intact, not digested, long enough to be absorbed by a bacterium. Then, if the DNA were taken up by the bacterium, it would have to become incorporated into the bacterium's own chromosome through a rare process of illegitimate recombination. Assuming the gene was actually

integrated in the correct position within the bacterial chromosome, the recombinant bacterium would have to transfer the antibiotic-resistance trait to a pathogenic bacterium (Smith, 2000).

While no one actually has been able to demonstrate that a transfer of resistance genes has occurred in the human gut, the threat exists. Some disagreement exists about the medical consequences of anti-biotic resistance created by GM crops. The British Medical Association suggests that marker genes are a large health threat, but others agree that the impact of resistance created by biotechnology is insignificant because a pool of antibiotic resistant non-pathogenic bacteria already exist (Smith, 2000). Regardless of current risk, researchers should find alternatives to antibiotic-resistance marker genes.

While there is no such thing as zero risk for any food, eating foods produced from genetically modified crops may contain some extra DNA that is hidden among the DNA already in the food, but do not cause additional harm.

**Environmental Concerns**

In the highly publicized report in the scientific journal *Nature,* John Losey and his colleagues at Cornell University reported that Bt corn pollen could kill Monarch butterfly larvae (National Academy of Sciences, 2001). Opponents of genetically modified crops held the report as evidence that biotechnology is devastating to the environment. On the other hand, supporters of GM crops quickly dismissed the study as preliminary in nature and unrepresentative of real farm conditions. Outside a laboratory, the larvae have other feeding options, eggs are typically not laid on milkweed plants in cornfields, the Monarch's migratory pattern does not bring it in contact with corn during pollen shed,

and the toxin could be deactivated by environmental factors (Smith, 2000; National Academy of Science, 2001). Regardless of inaccuracies, the Monarch butterfly article catalyzed more investigation into possible environmental impacts of biotechnology.

While more studies need to be conducted, harm to nontarget insects and other animals is a major ecological concern regarding insect-resistant GM crops. Although Bt toxin generally becomes quickly inactivated in the soil, the toxin can bind with soil particles and retain its insecticidal properties for 230 days or more. As a result, Bt toxins may accumulate to higher concentrations in the soil than previously expected and possibly affect earth-bound organisms or impact decomposition and nutrient cycling (Marvier, 2001).

Throughout history, introduction of a non-native species into a new habitat lacking natural predators, such as kudzu and multi-flora rose, have resulted in the plants becoming aggressive weeds with devastating environmental and economic consequences. Consequently, the possibility exists that insect-resistant crop plants are more likely to become invasive weeds than traditional varieties. Further problems may result from a transgenic crop plant crossing with a related non-crop species, creating new weeds. While this risk is derived from a rare, chance event and may take decades to occur, the danger is increased by the lack of environmental monitoring creating the likelihood that detection would only occur after a problem develops (Marvier, 2000).

On February 8, 2001, another article in *Nature* reported, "A ten-year survey of genetically modified (GM) crops has found that they do not survive well in the wild, and are no more likely to invade other habitats than their unmodified counterparts (Whitfield, p.1)." Michael Crawley, an ecologist at Imperial College in London, and his team

planted experimental plots of herbicide resistant corn, sugar beet and oilseed rape varieties, and two potato varieties bioengineered to be insect-resistant. Grown at 12 sites in the United Kingdom next to their unmodified counterparts, the plants did not invade neighboring unplanted areas or become self-seeding, self-sustaining populations. According to the report, GM and non-GM plants performed equally bad and all plots of corn, sugar beet and rape died out within four years. Only one plot of unmodified potatoes lasted the full ten years (Whitfield, 2001). Crawley explains, "The possibility that GM traits might move into weeds is irrelevant if the hybrid isn't more competitive than it otherwise would have been (Whitfield, p.6)." Although this is encouraging news, GM crops should still be evaluated for potential risks on a case-by-case basis.

Another ecological concern is the potential for pests to develop resistance to the genetic modifications created to control them. Overuse of the same control measures for insects and weeds increases selection pressure on these organisms, enabling the evolution of resistance and ineffectiveness of current controls. Strategies to manage the development of resistance are urgent and needed for all uses of a pesticide both spray and plant-incorporated combined. Most importantly, the same pest management program should not be used in the same field every year. Not only would the consequences of pest resistance create useless technology, but may impact the environment adversely by requiring the use of more harmful chemical pesticides.

Organic farmers are particularly concerned about emerging resistance to Bt toxins because Bt sprays are widely used in organic practices. In response to this concern, the EPA developed an insect resistance management plan. Implemented for the 2000 growing season, the insect resistance management plant directs growers to maintain at

least a 20 percent non-Bt corn refuge within a Bt cornfield. For cotton fields, the refuge must be at least 50 percent. Also, the EPA requires increased monitoring and restrictions on planting Bt crops in certain areas (Smith, 2000).

Environmental impacts of transgenic crops warrant further investigation to avoid adverse effects. Protecting the environment is a challenging task and predicting actual effects on ecology will be very difficult.

**Economic Concerns**

As a result of the lengthy and costly process to develop a genetically modified organism, agri-biotech companies want to ensure a profitable return on their investment; therefore, many genetic engineering technologies and GM plants have been patented, and patent infringement is a big concern of agribusiness. With price increases to compensate for development and patenting, seed companies charge farmers a technology fee as an additional cost for the seed. Consumers are concerned that increased seed price will widen the gap between the rich and the poor because small farmers and third world countries will not be able to afford seeds for GM crops (Whitman, 2000).

According to USDA Economic Research Service, "the overall downward trend in pesticide application rates on major U.S. crops from 1996 to 1998 appears to confirm the pesticide-reducing effect of GE crops (Agricultural Outlook, 2000)." If genetically modified seed allows the grower to reduce pesticide, then even with the additional technology fee, farmers are able to save money (and most of the farmers I talked to would agree).

The best way to secure a decrease in the prosperity gap would be for more companies and non-profits to follow the Rockefeller Foundation and offer their products at reduced cost to impoverished nations. Also, Monsanto's pledge to abandon all suicide gene technology can alleviate financial disaster to farmers in third world countries who cannot afford to buy seed every year (Whitman, 2000).

**Religious/ Ethical Concerns**

Some vegetarians and religious groups have had concerns regarding gene transfers between different organisms. First, it is important to realize that a specific gene does not characterize an organism; the products of all of the genes of the organism's genome determine its species classification. Because many of the same genes are found naturally in both plants and animals in a universal code, scientists are able to move genes from one organism to another (American Dietetic Association, 1999).

Also, according to Vatican officials, "We cannot agree with the position of some groups that say it (genetic engineering) is against the will of God to meddle with the genetic make-up of plants and animals. Vatican experts voiced a 'prudent yes' to genetic engineering of plants and animals, but restated Church objections to human cloning and other biotechnologies that modify the human genetic code (Thavis, 1999)." Further, "We are increasingly encouraged that the advantages of genetic engineering of plants and animals are greater than the risks. The risks should be carefully followed through openness, analysis and controls, but without a sense of alarm,' said Bishop Elio Sgreccia, vice president of the pontifical academy (Thavis, 1999)."

**Labeling Concerns**

Probably, the most controversial issue regarding GM food is whether or not labeling should be required for all genetically modified food products. The FDA's current position on food labeling is governed by the Food, Drug and Cosmetic Act that is only concerned with food additives, not whole foods or food products that are considered "GRAS" (Generally Recognized As Safe). Because the FDA establishes its policies according to the products themselves and not the technology used to develop them, labeling of foods according to method of production would not provide useful information on safety or nutritional value of the food. On the whole, agribusiness industries believe that labeling should be voluntary and influenced by the demands of the free market. If consumers show preference for labeled foods over non-labeled foods, then industry will have the incentive to regulate itself (Whitman, 2000).

I do not think that consumers and activists realize that additional costs will be associated with mandatory labeling. At the food production level, separate processing lines would have to be implemented, farmers would have to keep GM-crops separate during planting, harvesting, and shipping, buffer zones would need to be planted to prevent cross-contamination, and expensive DNA testing would be needed to maintain separation of products. Also, there would be additional cost in regulating the industry to ensure compliance with the labeling law. Finally, who would be responsible for educating the public about the new labels, not an inexpensive task, I'm sure.

## FOCUS GROUP STUDY

### Approach

If public misconceptions about genetically modified foods do exist, what are they and where did they come from? Before anything can be done to alleviate consumer's "genetically modified confusion," I found it important to identify specifically what most people already know about this technology, how accurate their information is, where they obtained this data, and what exactly are they concerned about. Rather than conducting a survey and only discovering what percentage of respondents know or do not know a specific fact, I used a series of four focus groups to probe consumers not only to discover what they know, but what they think and how they feel about genetically modified food.

### Method

Popular in marketing research, focus group interviews can be used for a wide range of studies and may vary accordingly in degree of structure, number of groups, types of participants, and, of course, cost. According to David Morgan in *Planning Focus Groups*, there are three basic levels of structure applied to focus group studies. A high level of structure emphasizes specific goals and uses a questioning format composed of a large number of narrowly focused questions that are highly controlled by the moderator (Morgan, 1998). While a more structured group provides answers to a set of direct questions, a low level of structure provides for studies with an exploratory purpose and reveals the participants' perspective on the research topic (1998). Although my primary interest was to learn as much as possible about the participants' attitudes towards genetically modified food, I also wanted to discover how much the consumers already

knew about this technology. With these two goals in mind, I selected a moderate level of structure to balance the discussions between my interest in their understanding of genetic engineering and the group's interest in verbalizing their thoughts and opinions.

After determining the level of structure to use, I was ready to prepare the questions. From author Richard Krueger in *Developing Questions for Focus Groups*, I learned that moderately structured focus groups command a "funnel design" questioning route beginning with broad, open-ended questions, progressing to a set of central topics to concentrate the group on core topics, and finally, concluding with specific questions (Krueger, 1997). Krueger also suggests using only conversational language when wording the questions and to provide a quick, easy opening question to warm up conversation and to help the participants feel comfortable answering (1997). At the beginning of each of my sessions, I asked participants to name their favorite flavor of ice cream. While this question does not appear on the interview transcripts because it is irrelevant to the study, the most popular flavor was vanilla for anyone who may be interested.

In order to introduce the general topic of discussion, I asked two broad questions to allow participants to tell about their understanding of genetically modified food. In a conversational manner, I first asked the focus group to describe what they think genetically modified food is, and then "what are you hearing people say about genetically modified food?" Not only did these introductory questions provide me with data to indicate the degree of initial understanding the group held, but provided some background to participants with little initial awareness.

Narrowing my specificity of questions, I asked the focus group to indicate where they hear information about genetically modified food and their feelings of truthfulness that they are receiving from the named sources. From these two transition-type questions, I hoped to receive insight to where misconceptions might originate and the levels of confidence consumers invest in this information.

After the focus group discussion was well underway, I typically told the group they were now in a brainstorming session to reveal possible benefits as well as possible problems with genetically altered foods. With these two questions, I wanted to enable the group to think critically about the topic. From their responses, I wanted to be able to speculate whether the group's overall attitude about biotechnology was positive or negative.

Finally, my last question was "what questions do you have about genetically modified food?" While providing me with information about the participant's specific concerns, I hoped their responses to be the product of all other previous discussions.

According to Morgan, a typical smaller focus group project consists of two to four groups and uses easily available recruitment sources for the focus group participants (Morgan, 1998). For my study, four groups were interviewed, a group of high school students, a group of college students, a group of urban-based consumers, and a group of farmers. I found it important to interview some farmers because I was interested in their concerns, and if they are not well informed, then confusion about biotechnology may be worse than I originally assumed. Because productive conversation is important to the success of individual focus groups, it is important for participants to be comfortable talking to each other about the topic (1998). Homogeneity is particularly important to

ensure high levels of productivity because participants will spend less time explaining themselves to each other and more time discussing the issues (1998). In all four groups studied, the members within each group shared a common social environment, such as work or school, and were of similar age, educational level, income, and marital status. Although group size varied from three to six participants, I think that size naturally varied according to participants' level of involvement. Considering the charitable nature of the respondents' participation, I did not refuse extra volunteers or have grounds for enforcing participation when attendance was low.

By far, the most difficult challenge I encountered was arranging the actual focus group interviews. First, I interviewed a group of 6 high school students. Arranging for that interview was relatively easy, my old high school science teacher was willing to help me out in the name of research, and high school students are willing to do anything to get out of class and eat sweets. Because I wanted to practice my moderating skills in an environment where I would not feel any intimidation, I chose to interview the high school group first. The participants were selected by Mr. Daye, and the interview was conducted in the library of Fairfield Local High School in Leesburg, Ohio.

After being canceled once and rescheduled due to snow, I finally met with a group of female, middle-aged consumers in Cleveland, Ohio. The interview was conducted in an office room at their place of work. Although more people were scheduled to participate, only three consumers were actually interviewed. While I was initially concerned about the small group size, the participants were highly involved, sharing detailed stories and personal accounts. After transcribing the tape, I felt that if more people had been included, the depth of participation realized might have suffered.

Recruiting college students for my study was defiantly the most difficult group to orchestrate. Not only do college student have extremely sporadic schedules which presented arrangement challenges, but they were less willing to donate their time for the discussion. In retrospect, I think that lack of enthusiasm for the topic was directly related to lack of participation. All students at the Ohio State University, the four participants in this interview met in my living room.

Because of direct interest in the topic, coordinating an interview with a group of farmers was very easy. Near my hometown of Leesburg, Ohio, I attended the local Farm Bureau Council meeting and interviewed six farmers in a member's dining room.

**Results and Discussion**

GROUP 1 – HIGH SCHOOL STUDENTS
6 PARTICIPANTS- 3 MALE, 3 FEMALE

Q1. DESCRIBE GENETICALLY MODIFIED FOOD

3 of the participants were able to provide some correct information, only one person indicated they didn't know any information, and 2 were somewhere in the middle.

"they change the characteristics of it so that it is more appealing to consumers"

Q2. WHAT ARE YOU HEARING ABOUT GENETICALLY MODIFIED FOOD?

Similar to traditional breeding, moral issues, health concerns

"I think it is (what Mendel did) only just more high tech"

Q3. WHAT IS THE SOURCE OF MOST OF YOUR INFORMATION ABOUT GMO FOOD?

TV, science magazines, teacher, peers

Q4. DO YOU FEEL SOURCES ARE TRUSTWORTY?

Found news reporting trustworthy not teacher

"we trust everything more than Mr. Daye"

Q5. NAME POSSIBLE BENEFITS

Nutrition, vehicle for vaccines, adapt plants to harsh weather conditions in other countries, better products

"maybe in other countries they can adapt the stuff to the weather or whatever so they could grow somewhere else"

Q6. NAME POSSIBLE PROBLEMS

Public acceptance, side effects, allergies, economic concern for farmers, economic effect on trade

"they have to understand it because people are scared of what they don't understand"

Q7. WHAT QUESTIONS DO YOU HAVE ABOUT GENETICALLY MODIFIED FOOD?

Large response! In order of most common to least common- affect on farmers and industry, how GMOs are developed, how are they regulated, health concerns, public perception, possible improvement with use of GMO

"I won't worry until it affects other people or kills someone"

"I don't know, I really don't see any problems with it"

"I just think that it's probably a good idea that we try to develop new food to make it healthier so that people will probably live longer maybe it will enhance our ability to think, I'm not really sure but it sounds good"

"it takes a lot to surprise us because we have so many new discoveries coming along everyday...your older people who have, you know, eaten a lot more garden-grown products their whole life might feel differently"

Originally, I thought this group would be more concerned with environmental impacts; however, they did not acknowledge this concern. I felt this group was relatively aware of the science behind the development of GMO food. Since these participants have not fully developed deep critical thinking skills, they seemed more impressionable (believe TV) and very concerned about what other people thought. Also, moderating this group proved to be an incredible challenge. The participants wanted me to answer their questions directly, and they wanted to know my opinion before they answered. I tried my hardest not to offer examples, which would introduce bias, and often I would accidentally respond to their answers, especially the surprising ones, such as, "you trust the news more than Mr. Daye." After the first couple of questions, I was more comfortable during the periods of silence and often just interrupted the quiet by rephrasing the question. Because this group was able to think of a lot of benefits and seemed interested in the science behind genetic modification, I would consider this group to be proponents to GM food.

GROUP 2- Urban-based consumers
3 PARTICIPANTS- 3 FEMALE

Q1. DESCRIBE GENETICALLY MODIFIED FOOD

2 knew, 1 didn't

"I don't really know, you know when I hear something like genetic it's just not natural"

Q2. WHAT ARE YOU HEARING ABOUT GENETICALLY MODIFIED FOOD?

Bt corn kills Monarch butterflies, Golden rice, not enough studies done to understand impacts, Bovine Growth Hormone, some people say it's better for you and some say it's worse

"I think that people are really scared because they don't believe that agriculture conglomerates are going to take that kind of care"

"it goes over my head most of the time"

"when I was at the food co-op the other day there was a uh you could sign to boycott Kraft products"

"people want to know they want to have a choice whether they're getting something that's been genetically modified or not"

Q3. WHAT IS THE SOURCE OF MOST OF YOUR INFORMATION ABOUT GMO FOOD?

Media

"I never see it"

"I very rarely go and seek information (about GMOs)"

"usually there really isn't that much publicity in the paper and not that much on the radio"

Q4. DO YOU FEEL SOURCES ARE TRUSTWORTY?

"I don't think that most people myself included truly understand all there is to know it"

"just don't tell me I don't want to know"

"I only trust the media if I feel that I'm getting a good..information on both sides"

Q5. NAME POSSIBLE BENEFITS

Nutrient packed rice, help starvation and malnutrition, less chemical inputs, cheaper food

"if a cow could be genetically altered...and never have to introduce any type of artificial hormone or antibiotic that would then be a part of our food chain I would much rather go for the genetic engineering"

"I don't know you know because I'm very much into the organic-type food and I don't know if you could have organic and have genetically engineered you know and they say that organic is supposed to be so good for health ...where the chemicals aren't there"

Q6. NAME POSSIBLE PROBLEMS

Harm to nontarget populations, health risks, if problem occurred in GMO product there would be no way to trace it and get it off the shelves

Q7. WHAT QUESTIONS DO YOU HAVE ABOUT GENETICALLY MODIFIED FOOD?

How healthy, any side affects, invested research dollars/cost, who supports this idea, what foods are genetically modified, why aren't more people informed,

"I guess my question is why isn't it more on the media, if there's a lot going on right now why isn't there more out there to tell people about this"

"people really aren't that interested"
"I'm not (interested), if there's an article in the paper I'd probably pass it by and not even read the first paragraph"

From this interview, I developed a lot of insight about perception formations regarding GM foods. In this study, there are three participants, one that is relatively well-informed about biotechnology (J on transcription) and while she realizes there are potential dangers, she sees the potential benefits and "would much rather go for the genetic engineering." On the other hand, one respondent (M on transcript) is an organic food consumer and while somewhat informed about GM food, she is primarily exposed to anti-GM propaganda at the food co-op and did not name any potential benefits specifically. Also, as an organic food consumer already paying extra for pesticide-free food, reduced pesticide use is not a reason for her to accept the GM crops. In the middle, is the third participant, who I think is more representative to the larger population, she admitted that she could be swayed either way and until we started talking about GM food really did not realize it was an issue.

After revising my instructions, my moderating skills were enhanced. This group functioned really well maintaining a discussion rather than answer naming like in the previous group. I also think that because of having to reschedule the meeting, the participants had time to anticipate the interview and were a lot more energetic.

GROUP 3- College Students
4 PARTICIPANTS- 3 MALE, 1 FEMALE

Q1. DESCRIBE GENETICALLY MODIFIED FOOD
3 knew something, 1 "I don't know"

Q2. WHAT ARE YOU HEARING ABOUT GENETICALLY MODIFIED FOOD?
All negative, health problems
"actually, I just tend to hear the negative of it

Q3. WHAT IS THE SOURCE OF MOST OF YOUR INFORMATION ABOUT GMO FOOD?
TV, and an acquaintance
"yeah just tv"

Q4. DO YOU FEEL SOURCES ARE TRUSTWORTY?
No
"yeah they're biased"

Q5. NAME POSSIBLE BENEFITS
Disease resistance, health benefits to people, higher yields, product enhancements, less pesticides
"I guess with more resistance to disease that means less pesticides maybe uh less crop loss due to insects"

Q6. NAME POSSIBLE PROBLEMS

Public perception, unpredictable negative impacts, moral issues,
"the whole public thing, people are afraid of chemicals they think they're bad"
"you get certain good traits but you don't know what exactly the bad traits are sometimes, well if you do the public perceptions seem to be on the what if there was a bad trait that we don't know about, religious reasons some people think that this isn't something we should be doing"
"they could ruin the soil or something like that so that they can't grow something anymore"

Q7. WHAT QUESTIONS DO YOU HAVE ABOUT GENETICALLY MODIFIED FOOD?

How are GMOs developed, affect on cost, health concern, what product enhancements are possible, economic concern, distribution/regulation concern
"are all farmers going to be able to afford to buy it and produce the seeds"
"obviously it's not going to be the small farmers developing this type of food, it's going to be the big agricultural firms are they going to be the ones that control it and then eventually who is going to be the ones that controls them and who controls, I'm sure there's a government agency involved and who watches out for them"

From taking Plant Pathology 597 last quarter, I had become somewhat familiar with some views held by college students regarding biotechnology. In this discussion based class where students of highly varying backgrounds and a wide range of majors were required to learn about pesticides and genetic engineering, I felt that the students were split half and half on their approval of genetically modified foods. Some of their negative concerns included: moral problems, fears of general negative environmental impacts from genetically modified organisms, danger to non-target organisms including soil microbes, vegetarian consumers not wanting to eat animal DNA, possible health risks due to lack of long term studies, and possible introduction of allergens.

During this session, I expected to hear responses similar to the students in my class; however, the group seemed relatively disinterested in the topic either way. The students from the class must have developed their opinions from researching the subject for the course. I think that these participants did not find GM food a threat and were more interested in the science behind it. Unfortunately, a true discussion never developed within the interview, maybe the topic was boring to them or maybe I was less enthusiastic.

GROUP 4- Farmers
6 PARTICIPANTS- 6 MALE

Q1. DESCRIBE GENETICALLY MODIFIED FOOD

All were very aware, although I doubt they know about the methods

Q2. WHAT ARE YOU HEARING ABOUT GENETICALLY MODIFIED FOOD?

People are unaware, don't care, have agendas for being an activist, producers had reasons to accept technology and consumer didn't, Monsanto cared more about technology fee than educating consumer, activist groups are more vocal

"yeah I agree probably beyond not know I think that most people don't care"

"there is more money in fighting anything than there is going along with it, there is a lot of money to be made in arguing things because a lot of people donate to these people and really feel like they're doing some good and I think that's the same mentality that we're fighting with this"

"Monsanto was their own worst enemy when they released this because they were going to sue everybody if they did this or did that and they were making too much fuss about that and they never said anything about the good part of it"

Q3. WHAT IS THE SOURCE OF MOST OF YOUR INFORMATION ABOUT GMO FOOD?

Farm magazines and the internet

"our problem is we get it all from the pro sides and don't get any of it from the negative sides"

Q4. DO YOU FEEL SOURCES ARE TRUSTWORTY?

Farm magazines are mostly for GMOs and the popular press is mostly negative-everything is one sided

"I think we need to look at it from the standpoint of who is having the more affect on the masses"

Q5. NAME POSSIBLE BENEFITS

Less chemical carryover and less chemical pollution, better nutrition, "cheaper for us to put out," produce more, better, quicker using less area,

"if you look at how many faces there are to feed and we farm a very small portion of this world and the more that can be produced, you know when people talk about organic crops and such, I mean we could go back to that method of production but we would have to tear up every rain forest in South America to do it and so ideally if we could produce more, better, and quicker to using less area and less chemicals we're better off in terms of the environment and the consumer both"

Q6. NAME POSSIBLE PROBLEMS

Advancing too quickly will lead to adverse drawbacks, moral issues, public perception, illegal to save seed,

"the first problem I see is going too far too fast, the Roundup Ready thing's worked because it was basically simple but we've got some biotechnology that's happening especially in the animal line, talk about cloning and we get to the point that we're going so far so fast that there's going to be some drawbacks that are going to be more adverse that the one step at a time"

Q7. WHAT QUESTIONS DO YOU HAVE ABOUT GENETICALLY MODIFIED FOOD?

> Health risks, out crossing to weeds, safety before release, potential for contamination
> "I want them to make sure they're safe before they ever release them"
> "Starlink corn was released too soon"
> "but still I don't feel comfortable that I'm being told everything they know and I don't think they know everything so there is..."

Because of their direct interest in the topic, I had plenty of participants for this interview. While not everyone was very vocal, they would react non-verbally according to the discussion. As I had anticipated, the participants were well informed about the topic. Also, hearing their perspective provided some useful idea. For example, one respondent suggested if Monsanto had focused more on educating the public and less on suing the farmers, then possibly fears about biotechnology could have been contained. They assured me that biotechnology did reduce their production costs and realized less pesticide use. Their concern of pollen drift led one person to suggest that maybe his crops were cross-pollinated with Bt pollen because he didn't plant Bt corn yet had no more corn borer problems after Bt corn became available. Reassuring to know is that the growers were very concerned about safety, they don't just produce GM products for economic reasons. They were disappointed about the Starlink mix-up and said "Starlink corn was released too soon."

**Conclusion**

One of the major disadvantages of focus group analysis is that the results cannot be used as evidence in a conclusive research manner. First, the sample is not representative of the entire population in the sense that quantitative statements can be made about the significance of the research findings. Second, the evidence itself is highly dependent upon the experience and perception of the moderator. From my lack of experience with focus group analysis and my need to maintain a small budget, my procedures definitely could have been enhanced by better recruitment of participants, more professional environments for my interviews, and increased skills as a moderator. While I feel that I have a large potential to become a highly skilled moderator, I think that years of experience would contribute to excellence in moderating.

Because I hear so much anti-GM activism, I thought that the consumers I interviewed would have provided more negative feedback than I received. Also, I expected more of the participants to hold a strong view of whether they considered genetic engineering good or bad. I realize that anti-biotech activist groups are strong and convincing and I had anticipated that more participants would have brought up the issue of labeling or consumer right to know. Only one participant brought up the labeling issue. Even though most people were able to name more problems than benefits, I felt that the substantial majorities were either indifferent or accepting of genetically modified foods. After my study, I would agree with the farmer group in that the majority of consumers do not care either way.

## LITERATURE CITED


Agrios, G. (1997). *Plant Pathology 4th Ed.* (pp. 79). Academic Press: San Diego, CA .

The American Dietetic Association. (1999). Food Biotechnology: Safe, Nutritious, Healthful, Abundant, and Tasty Food. http://www.eatright.org/nfs/nfs9.html.

Campbell, N. (1996). *Biology 4th ed.* (pp. 239-241, 284-286, 302-303, 388, 407). Benjamin/Cummings Publishing Co: Menlo Par, CA.

Carpenter, J. (2001, January). Case Studies in Benefits and Risks of Agricultural Biotechnology: Roundup Ready Soybeans and Bt Field Corn. *National Center for Food and Agricultural Policy.* NCFAP: Washington, DC.

Consumers Union. (1999, June 11). Summary of Public Opinion Surveys Related to Labeling of Genetically Engineered Foods. *Consumers Union* [online]. http://www.consumer.org/food/summpollny699.htm.

Environmental News Network. (2001). GM food quiz. http://www.enn.com/features/2000/09/09062000/gmfood_30998.asp#ENN_INTERACTIVE.

FEED, Inc. (2000). Altered States. *FEED Magazine* [online]. http://www.feedmag.com/dna/states.html.

Gasson, M., Persley, G., Qualset, C., & Siedow, J. (1999, December). Applications of Biotechnology to Crops: Benefits and Risks. *CAST Issue Paper* No. 12. CAST: Ames, IO.

Haerlin, B. & Parr, D. (1999, August 5). How to restore public trust in science. *Nature* [online]. http://www.junkscience.com/aug99/haerlin.htm.

Hanrahan, C. (1998). U.S.- European Agricultural Trade: Food Safety and Biotechnology Issues. *Congressional Research Service* [online]. http://www.cnie.org/nle/g-51.html.

Hansen, Michael. (2000, September 26). The Future of Food: Biotechnology and Consumer Confidence. *Consumers Union.* http://www.consumer.org/food/senatecpi900.htm.

International Food Information Council. (2000, July/August). Guess Who's Coming to Dinner? *Food Insight* [online]. http://ificinfo.health.org/insight/JulAug00/dinner.htm.

International Food Information Council. (2000, June 12). U.S. Consumer Attitudes Toward Food Biotechnology. *IFIC Background.* IFIC: Washington, D.C.

James, C. (1999). Global Review of Commercialized Transgenic Crops: 1999. *ISAAA Briefs* No. 12: Preview. ISAAA: Ithaca, NY.

Koning, Ross. (1997, March 3). Re: Public perception of Cloning. *Plant-tc Monthly Archive* [online]. http://www.agro.agri.umn.edu/plant-tc/listserv/1997/log9703/msg00015.html.

Krueger, R. (1997). *Developing questions for Focus Groups.* Sage Publications: Thousand Oaks, CA.

Lewis, P. & Kendall, R. (2000, June 29). Session I – A Set of Scientific Issues Being Considered by the Environmental Protection Agency Regarding: Food Allergenicity of Cry9C Endotoxin and Other Non-digestible Proteins. *SAP Report No. 2000-01A.* FIFRA Scientific Advisory Panel.

Mangino, M., & Chism, G. (2000). A Study Guide. *The Science of Food* (pp. 43, 56-58). The Ohio State University, Columbus.

Marvier, M. (2001). Ecology of Transgenic Crops. *American Scientist* [online]. http://americanscientist.org/articles/01articles/marvierintro.html.

Monsanto. (2001). How Biotechnology Works. *Biotech Basics* [online]. http://www.biotechbasics.com/how.html.

Morgan, D. (1998). *Planning Focus Groups.* Thousand Oaks: Sage Publications.

National Academy of Sciences. (2001). U.S. Regulatory System Needs Adjustment as Volume and Mix of Transgenic Plants Increase in Marketplace. *The National Academies.* http://www4.nationalacademies.org/news.nsf/isbn/0309069300?OpenDocument.

National Center of Biotechnology Education. (2001). Techniques of Plant Biotechnology. The University of Reading. http://www.ncbe.reading.ac.uk/NCBE/GMFOOD/techniques.html.

National Food Processors Association. (2001). Biotechnology : Coming of Age for the 21st Century. *Biotechnology Fact Sheet* [online]. http://www.nfpa-food.org/science/biotech.html.

Ohio State University Extension. (1998, October 2). Pesticide User's Guide, Bulletin 745-Relative Toxicity of Pesticides. http://www.ag.ohio-state.edu/ohioline/b745/b7452.html.

Ray, D. & Guzzo, L. (1990). *Trashing the Planet.* New York: HarperCollins Publishers, Inc.

Ronzheimer, M. (1999, June/July). A new social contract for science. World Conference on Science – Budapest, Hungary. Berlin: Berlinews. http://www.berlinews.de/archiv/523.shtml.

Smith, C. (1995). *Crop Production, Evolution, History, and Technology* (pp. ). John Wiley & Sons, Inc.: New York, NY.

Smith, N. (2000, April 13). Seeds of Opportunity: An Assessment of the Benefits, Safety, and Oversight of Plant Genomics and Agricultural Biotechnology. *Report of the Subcommittee on Basic Research and Transmitted to the Committee On Science for the One Hundred Sixth Congress 2nd Session* [online]. http://www.house.gove/science/smithreport041300.pdf.

Tapestery. (2000). Public Misconceptions of Science. The Institute for Philosophy, Religion, and the Life Sciences, Inc. http://www.stormwind.com/common/responsibility.html.

Thavis, J. (1999, October 22). Vatican Experts OK Plant, Animal Genetic Engineering. *St. Louis Review.* Vatican City (CNS).

Tortora, G., Funke, B., & Case, C. (1998). *Microbiology, An Introduction 6th ed.* (pp. 253, 261). Benjamin/Cummings Publishing Co: Menlo Par, CA.

Union of Concerned Scientists. (2000). Foods on the Market. http://www.ucsus.org/agriculture/gen.mrket.html.

USDA Economic Research Service. (2000, August). Genetically Engineered Crops: Has Adoption Reduced Pesticide Use? *Agricultural Outlook* [online]. http://www.ers.usda.gov/epubs/pdf/aer786/.

Whitfield, J. (2001, February 8). Biotechnology: GM plants make weedy weeds. *Nature* [online]. http://www.nature.com/nsu/010208/010208-9.html.

Whitman, D. (2000, April). Genetically Modified Foods: Harmful or Helpful? *Cambridge Scientific Abstracts* [online]. http://www.csa.com/hottopics/gmfood/oview.html.

## APPENDIX 1: Focus Group Transcriptions

### Group 1- High School Students, 6 participants

DESCRIBE GENETICALLY MODIFIED FOOD

P-it looks good
S-don't know
T-food grown in fertilizer
E-are you thinking of hydroponics
T-maybe that's it
E-um they're going to make plants more disease resistant, make bananas without big seeds, easier for us to use
L-they change the characteristics of it so that it is more appealing to consumers
C-I was going to say what she said
S-seedless grapes
E-watermelons too

WHAT ARE YOU HEARING ABOUT GENETICALLY MODIFIED FOOD?

L-Mr. Daye talks about people playing God in a way
C-that it's not as good for you because it's not as natural
P-nothing
L-they take certain genes away from it and add certain things to make more to make it better
E-I guess it's hard to say they're playing God if you're going to have doctors basically playing God every time they treat a patient it's the same thing with plants
T-what about the guy that did stuff with the peas or whatever, isn't the same thing
M (yeah oops)- I don't know what do you think
T- I think it is only just more high tech
??

WHAT IS THE SOURCE OF MOST OF YOUR INFORMATION ABOUT GMO FOOD?

E-Discover magazine or something like that
C-Mr. Daye
T- someone talked about it in speech class
S-??(can't hear on tape)
L-T.V.

DO YOU FEEL SOURCES ARE TRUSTWORTHY?

T,L-the news
M-you trust the news more than Mr. Daye
C-we trust everything more than Mr. Daye

NAME POSSIBLE BENEFITS

S-seedless grapes, because they don't have seeds

E-they take everything that's good about food and they keep it good and then they can remove all of the bad stuff, you could safe space on packaging like if you could grow a square apple then you could save space on packaging without really changing the apple
T-mumble
M-what are some other benefits
C-nutrition
L-yeah they might be able to make it more nutritional
T-vaccines

NAME SOME PROBLEMS

E-they have to understand it because people are scared of what they don't understand
T-there might be side effects
L-yeah they might have allergies to it
P-?(mumble)
E- could put farmers out of business because if they can't find a cheap way to do it it will cost a lot more

M-Can anyone think of anymore problems or benefits, this is a brainstorming session guys, you can think of more
P-we're distracted by candy
T-maybe in other countries they can adapt the stuff to the weather or whatever so they could grow somewhere else
L-but if we have to grow things in other countries then our import and export type deals would have to become more expensive and they would start charging more

WHAT QUESTIONS DO YOU HAVE ABOUT GENETICALLY MODIFIED FOOD?

S-what exactly is it...who does it, why do they want to do it
S-I've got a lot of questions
E-how much will it cost, will the taxpayers have to pay for any of it
T-how long does it take to do this
L-what is used in doing it
E-does the FDA have to re-approve everything that goes thru it
S-what do they do with the seeds in the grapes
P-can it kill you
S-I hope not I eat seedless grapes everyday
E-how much money can it save
L-what are the possible chances of it harming us
E-what industries will be put out by it
T-are some of the farmers going to end up going on a wild killing spree
L-disgruntled farmers
P-you're not allowed talking about that in school
M-C, I know you have questions
C-well, I guess I was wondering what's going to happen to the farmers because their whole lives they've been farming what are they going to do, work in a factory, that's not going to be good for them
E-thinking about biological warfare on a plant, if you have plant that's going to be not so good, maybe have a defect in it, then sell it to a bunch of people you could easily ruin them in a time of conflict or something
T-what's the public think about it, are they alright with it, do they really have a say in it

M-anymore questions, think about if you're going to eat this genetically modified food what questions do you want answered about it
S-I won't worry until it affects other people or kills someone
L-so when we're dying of Mad Cow disease we'll deal with where it actually came from
C-will it taste the same
S-i don't know, I really don't see any problems with it
T-can they only do it with plants what about cows, pigs and such, can they make it so like that pigs don't have any fat in the bacon, make it healthier for us
E-what if you changed the vegetables they eat so they don't make as much fat ...I want to know how they could use it in space

M-Do you guys have anymore..I'm going to do a quick rap-up then, so basically, you said that there are a lot of benefits, you said it could help nutrition, it could help um seedless grapes, you could get a better product from it, possible problems from it are hurting the farmers, you could possibly have allergies to it, we don't know a lot about it, but you said that maybe you weren't going to be too concerned about it until it starts hurting people, um do you guys have anything else to add in summary about what we talked about...

T-i just think that it's probably a good idea that we try to develop new food to make it healthier so that people will probably live longer maybe it will enhance our ability to think, I'm not really sure but it sounds good.

M-anymore summary comments
E-it takes a lot to surprise us because we have so many new discoveries coming along everyday that it would take a lot to faze us.
M-so you're saying that probably because you're young that you're a lot more open
E-your older people who have, you know, eaten a lot more garden-grown products their whole live might feel differently

**Group 2- Urban-based consumers, 3 participants**

DESCRIBE GENETICALLY MODIFIED FOOD

J-from my understanding genetically modified food is uh is food that has had it's DNA restructured in such a way as to um make it either easier to grow or more nutrient pack or resistant to insects or other bugs or something like that

S-I don't really know, you know when I hear something like genetic it's just not natural something's been added to it or taken away

M-I think of it as something that's done to change something in the food so that it's resistant um but their doing in a way that might leave unknown effects that we don't know down the road what will happen I know with like the corn I've heard that butterflies can be affected by this

WHAT ARE YOU HEARING ABOUT GENETICALLY MODIFIED FOOD?

J-primarily I hear opinions like M's that oh yeah this is going to be a scary thing and I have to admit that in a lot of ways that I do feel that way but I of course feel that it's uhm in the hands of the modifier what their modifying recently I read about they were modifying rice I believe that it

was rice so that it would have more iron maybe or was it vitamin D to help in countries that are really dependent on these as sole food sources to keep kids from getting Rickets I think it was vitamin D of course we're already eating food that is modified but its genetic structure hasn't been modified but most people are afraid that those are going to kill bugs you know if you make corn that is resistant to bugs that we think that maybe they really haven't done all of the studies necessary to show that it won't impact up adversely but I'd hate to think they'd stop the research because of you know one accident, you know what I'm saying you know like well they find out that the butterflies are dying and of course you want to know that and tweak it and try and modify it a little bit more whatever you need to do before you release it for use all over the world and I think that people are really scared because they don't believe that um agriculture conglomerates are going to take that kind of care, they're going to put their profit margins ahead of whatever it is or that the immediate needs like the preventing Rickets in children by modifying the rice so they have more vitamin D and they won't look at the long term, what happens down the road when they I don't know get vitamin Dosis or something like that I suppose it's possible to be toxic in some way

S-that was quit an opinion

J-what was the question (laugh)

S-it goes over my head most of time when I hear that some people think that it's a healthier way to live and other people think that it's not a healthier way to live and I don't care that much to make an opinion on it and some people are like do that, do that it's healthier and other people think it's not and I don't know, I could be swayed either way, last person I talk to probably or something

J-it's a big subject really, I mean
S-and it's not really something that I've really thought about
J-I mean genetically modified food that's, that covers a big scientific
M-and like with Bovine Growth Hormone like what they did with the cows and when I was at the food co-op the other day there was a uh you could sign to boycott craft products or to ah to somehow get on a petition or something like that so that um see Kraft uses cows that have the Bovine in it so they want it to be on their product they wat it to say that they've been given growth hormone and um so that's one thing that I've noticed out there that people want to know they want to have a choice whether they're getting something that's been genetically modified or not

WHAT IS THE SOURCE OF MOST OF YOUR INFORMATION ABOUT GMO FOOD?

J-for me it's probably um the media, television and newspapers and magazines, those are probably my primary sources, I very rarely go and seek information like when I'm cruising the internet I don't really look to much for the particular subject matter, however I will point and click to it if I have the time and read whatever it is but it is usually something that I'll hear Peter Jennings say that night or read in Newsweek the next week so I don't really seek it out too often

S-I never see it I mean I just, so now you're going to make me aware of so that's all I can tell you
J-well
S-so now
J-yeah everyday there something in the paper
S-I just never, never it's just something I skim through

M-yeah I really don't think that there's that much like, there was a while where there was a lot coming out about the corn and I heard something on the radio about it and I there was this big thing in Time magazine about it but then there was a little there for a while about the Bovine but then usually there really isn't that much publicity on in the paper and not that much on the radio

DO YOU FEEL SOURCES ARE TRUSTWORTHY?

J-trust no one (laughter) you know the conspiracy theorists, no really I don't feel that the they're completely trustworthy I think that it's a very difficult and complicated situation and I don't think that most people, myself included, truly understand all there is to know about you know what's the Bovine Growth Hormone or the use of antibiotics, I'm not in agriculture, I don't know about chickens and I don't know about corn and I'm a city girl and mostly I know from what I read that no I don't have a very deep understanding of the subject matter but what I do read is primarily written, it's dumbed down for Joe and Jane Doe to read um do I trust it, uh ... yeah I suppose I do trust it in a way that um on the surface, but I don't trust anything even if I heard that you know for example this guy that was convicted of rape you know even if they all come out today and say even oh it doesn't do this there is always this skeptic in the back of my mind that's thinking well they don't know everything about it yet, you know things could change

S-I think that when they tell you on TV I think that they think that they're telling you the truth I mean I think whoever told them and they think that's what they're telling you so I think that's true but I don't think that I'm going to change just like with the gas company, I still stuck with the original gas company and I think that's what I'd do this way, I mean I'm not saying that it's wrong you know but I'd probably never change

J-are you kind of like go, like a lot of us, just don't tell me, I don't want to know just don't tell me
S-right why do I have to make this decision
J-just don't give me anything else to worry about

S-I don't want to make a decision if they say do you want this kind or this kind I don't want that dissection I just want, what did I take last week that's what I'll take again this week, I could be swayed the other way I guess but I probably wouldn't voluntarily

M-I only trust the media if I feel that I'm getting a good uh .. information on both sides and if it seems really slanted in one direction and if it's not enough the other way then I'm going to be really suspicious, I've heard a really good like with the corn on NPR which I trust them more than some of the other media programs and it was really good because you got to hear Monsanto, is that the name of that company who does a lot of that stuff and then an independent research group, I don't remember where they were from, but you really got to hear their side of it and then you got to hear Monsanto and I liked that because you could really hear both sides, so I do and I don't trust the media

NAME POSSIBLE BENEFITS

J-there's no doubt that the benefits could be absolutely astounding to be able to supply a total nutrient uh packed rice that could be grown easily throughout Africa and Southeast Asia and China and places where starvation is real the very idea the very notion of that is just phenomenal but can you do that safely, can you do that safely and of course the impact on the US economy on the world economy specifically the United States, you know closer to home not having to use expensive chemicals and expensive things and production of our food is pretty inviting too you know the thought of things dropping in price of not having and not being exposed to chemical

pesticides and which I firmly believe is a real source of illness in our nation right now um different types of illnesses but you know when you look at underdeveloped countries and their rate of, just the other day I was reading about Alzheimer's Disease and the rate of Alzheimers in their exact counterparts as far as genetic makeup in this industrialized world we have a much higher rate, we have mush higher rates of almost all the cancers and I'm sure that has something to do with our exposure to chemicals in the environment, plastics and the use of insecticides and it would be nice to eliminate those types of chemicals from our environment and at least have better food

S-if that's true
J-yeah right if that's true
S-yeah that would be wonderful I don't know I have no idea

M-um I don't know you know because I'm very much into the organic-type food and I don't know if you could have organic and have genetically engineered you know and they say that organic is supposed to be so good for health I mean like people, cancer patients even go on organic and you know special diets where the chemicals aren't there, I don't know I think that there are probably room for organics and room for genetics at the same time, I don't even know how much I eat that is probably genetically engineered that I don't even know about because we don't get a lot of information that comes at you about that stuff

J-just think that if that cow could be genetically altered to produce more milk or to produce you know leaner meat or fattier meat whatever they were looking for in that particular animal and never have to introduce any type of artificial hormone or antibiotic that would then be a part of our food chain I would much rather go for the genetic engineering, I would like to see the studies done, now, yesterday, these studies should be in progress right now of course we'll never hear anything about them but the reality is that I would much rather I would much prefer that to be as long as there were no adverse reactions in our own bodies

S-but can we know that though

J-and we don't know that right now but they could feed it to some chimps and I wouldn't care, they could see what happens to them

NAME SOME PROBLEMS

J-well I think that the example of the insects you know that without thinking out the whole thing and studying it under nets for a long period of time, they introduced this food I believe it was corn but it might have been cotton for all I know but then suddenly discovered that all of these bugs that they hadn't intended to die were dead and then what do you do and then the birds have nothing to eat and then you know and it goes on and on and on I thik we have to be careful how much
S-she must of studied before we did this
J-no, nah, no
S-how do you know all of this stuff
J-i just do, you should meet my family you better know something
S-ok

J-so you might not be able to plant an entire field they kind of have to figure out how they're going to do it without impacting the environment adversely obviously they didn't think and then discovered the thing about the butterflies, they'll be on the endangered list, now they have to

think about that kind of stuff from an environmental impact sort of view and you know I don't even know if the EPA was involved in this

S-could there be any negative things to us personally, well if you have something wrong with you and it doesn't affect
J-well sure it could sure it could, they need to do more studies, but I believe that they can do most of these studies in computer models and in I really do I think they have the technology

S-they always put on these things on TV, if you don't have you know if you're not pregnant if you don't have a kidney problem so do you need to know that a head of time to know if these things might affect a disease you might have or may not affect if you do have these diseases, that would be really nice

J-so they really need to do these types of studies right away

S-every time there's something new oh that sounds good to me and they list everything and even though I don't have any of those things I don't want to take it, how do I know if I have heart trouble or liver problems or kidney trouble, I don't know if I have, I don't have them at the moment them maybe I will after I use one of these products I would never use them that they advertise that way so I don't know if these could be the same way, so I guess I'd be scared to take anything

M-i think that one of the problems with it is that the corn for example all of these farmers who have bought up all of this corn to plant and it was really large scale because that Monsanto is really a big seed vendor or whatever and say that there was a problem or whatever say that it was linked to cancer or something and then all of this is gone out and all these farmer and that's so much food, it's be impossible to try to get it off the shelves at that point

J-yeah I wonder really how much of that corn still is out there I would imagine it would be very difficult to keep track of the supply and where it exactly went especially with something that you don't ordinarily keep such close records on you know it's not a food source that is really prone to poison a population although I suppose it could, I'm sure some of that corn is still out there

WHAT QUESTIONS DO YOU HAVE ABOUT GENETICALLY MODIFIED FOOD?

S-how healthy it is for you and if there are any side affects for it what kind of chain reaction could happen from it, how much are we putting into this and maybe why money wise and research wise

M-that's a good question why

J-but I can think of several good reasons why though I mean just like we've developed antibiotic resistance, the chemical industry has encountered having to make several changes to their formulations because the population they are trying to eliminate or control somewhat get used to it and they have to up the anty on the insecticide on the chemical formulation yeah and that's pretty much a crap shoot too as far as really understanding what impact it has really once it actually gets out into the environment I'd rather see the genetic engineering

S-you what

J-I think I'd be safer for our food supply

S-who's really sponsoring this idea.. government, industry itself

J-actually Monsanto makes all kinds of stuff

M-she's not allowed to talk yet

S- I understand that I didn't even mean for an answer necessarily I just asked for my own curiosity

M-i don't know I just, I would like to know what I'm eating what are all of the foods I'm eating that are genetically modified that's not on the package you know is my pasta genetically engineered and I didn't know about it, I used to not trust the organic label because I thought that it probably wasn't really organic but I think I kind of trust it now

J-I just can't think of any questions I have about it

M-i guess my question is why isn't it more on the media, if there's a lot going on right now why isn't there more out there to tell people about this

J-because they'd rather hear what's going to happen to Sean Puffy Combs

M-who's that

J-and see if J-Lo's really left him, people really aren't that interested in it M, they're just not interested in it

M-yeah that's true

S-I'm not, if there's an article in the paper I'd probably pass it by and not even read the first paragraph

J-now you will read it

S-yeah now I'll look for it

J-it's there, it's there we just don't offer
S-well you seem to get it
J-yeah but I haven't read every article because there are some days you just can't be bothered, but it's out there....it becomes of course a hot topic and a topic I think people that science editors use as a little tool for educating now that it's out there and eventually most people I think will know more about genetically engineered foods...and maybe even genetic engineering for me, I'd like to have the fat gene turned off, please turn that off

M-there's like 30,000 genomes or something like that

J-you know they just released all that stuff and I didn't read it

J-ok next question

**Group 3- College Students, 4 participants**

DESCRIBE GENETICALLY MODIFIED FOOD

L-any type of food that's been selected to enhance certain genetic properties or any properties

N-I don't know

D-just food that like has some outside source put into it like chemicals and stuff

J-food that's been modified genetically

WHAT ARE YOU HEARING ABOUT GENETICALLY MODIFIED FOOD?

N-it could cause health problems and stuff like that

D-yeah that's about it

L-actually I just tend to hear the negative of it

J-honestly, the only thing I've heard about it was a cartoon in the Latern with this short guy with horns and extra limbs that says something like there's nothing wrong with genetically modified food that's all I eat

WHAT IS THE SOURCE OF MOST OF YOUR INFORMATION ABOUT GMO FOOD?

D- TV

N-yeah just TV

L-TV

N-you know actually the guy at the hydroponics' store next work talked about it a little bit

J-newspapers
DO YOU FEEL SOURCES ARE TRUSTWORTHY?

N-no not at all

L-no not really

D-yeah they're biased

NAME POSSIBLE BENEFITS

L-better resistance to diseases, I know they did that with potatoes

N-health benefits like not actually the plants themselves, but they could put stuff in it to help people

D-more prosperous harvests

J-I hate brussel sprouts, maybe it could make them taste better.

L-maybe they grow faster so they can produce more of it... taste... look, could appeal to some people

J-Maybe they could make a plant that can survive on less water, in my geology class were learning about how our groundwater resources are strained.

N-durability

L-I guess with more resistance to diseases that means less pesticides maybe uh less crop loss due to insects

NAME POSSIBLE PROBLEMS

D-the whole public thing, people are afraid of chemicals they think they're bad

L-you get certain good traits but you don't know what exactly the bad traits are sometimes, well if you do the public perceptions seems to be on the what if there was a bad trait that we don't know about, religious reasons some people think that this isn't something that we should be doing

J-Is is it possible that I would grow a third eye like that fish on the Simpsons?

D-just use of it, who is going to do this, I mean are all farmers going to be able to modify all of there crops and if they do it wrong then bad things can happen....they could kill their whole crop maybe or poison all of the food or do it wrong somehow and then the next crop they could ruin the soil or something like that so that they can't grow something anymore

N-I just keep thinking of attack of the killer tomatoes or something like that, bad vegetables

J-That wouldn't be so bad

WHAT QUESTIONS DO YOU HAVE ABOUT GENETICALLY MODIFIED FOOD?

N-is it going to be more expensive because obviously if they're using technology and putting more time into I don't know

D-with genetically modified food how exactly do they do it, I mean do they do it to the seed, do they do it when it's actually growing and then they put stuff on it or what

L-what exactly is genetically modified food, I mean everybody isn't sure, of course it's genetic so that means it has something to do with genes

N-will we ever have huge potatoes that you could eat off of for a week, big peas

D-yeah I saw that Woody Allen movie

J-I want to know that if this food will cause something to accumulate in my body that could affect my kids

L-and another question is how will it be distributed if it is improved, if there are improvements to it then that would mean there probably would be more of it, will it be distributed to just to people who pay for it or will it be used for other purposes like world hunger

D-are all farmers going to able to afford to buy it and produce the seeds

L-obviously it's not going to be the small farmers developing this type of food, it's going to be the big agricultural firms are they going to be the ones that control it and then eventually who is going to be the ones that controls them and who controls, I'm sure there's a government agency involved and who watches out for them

J- what if something toxic was discovered, how could they trace it

N-will it taste different

D-as long as there's no health problems I don't see anything wrong with it

**Group 4—Growers, 6 participants**

DESCRIBE GENETICALLY MODIFIED FOOD

W-welp, genetically modified just the gene pole's been modified just by having stuff introduced from something else whether it's been injected or whether it's been modified even by selection too an extra gene has been injected or removed or whatever

D-well we're being told that it's just a matter of time and we can do the same things through selective breeding that we've done for centuries that genetically enhanced products are done in a laboratory taking months instead of years

K-I guess that's the way I've always thought about it, food that's made from a product that's had a gene inserted to it from another plant or another whatever, but I guess the question is would some of those occur only through selection ... I think some of these could have been done eventually through selection over time

W-technology's advanced so much laboratory wise that it's just introduced a new avenue for us I mean in less than 100 yrs we've went from horse and plow to planters and combines. (tape cuts off)

WHAT ARE YOU HEARING ABOUT GENETICALLY MODIFIED FOOD?

D-I don't think that a majority of the consumers are even aware
B-or care
D-I think there's a small percentage of activists I guess I'd call them that are negative no matter what logic you use with them, it's bad because it's modified and there's probably another small percentage on the opposite end of the spectrum that thinks it's good, but I'd say the majority don't care

R-Probably those same ones that complain though have things in their lives that they accept that are a lot on the same line

D-well the typical argument that I would come up with is that, that activist got to that rally probably in an automobile that uses cancer-causing fuel that pollutes the air and you know
B- they probably even smoke cigarettes
D-probably

W- yeah I agree probably beyond not knowing I think that most people don't care... the only thing that I see is when we talk about the education of people on what they know the question comes back as what is being done, is it natural only in an escalated form and that's a question that I think everyone asks on everything

O- most of the problem that I see with this is like the spotted owl problem they had several years ago, I was at a meeting out in Indiana that this man who talked was with the Dept of Agriculture when Regan first few years and he said that the people fighting it that if you would agree with everything that they'd said that they would immediately take some other position just to keep it going because there was too much money in fighting it, there is more money in fighting anything than there is going along with it, there is a low of money to be made in arguing things because a lot of people donate to these people and really feel like they're doing some good and I think that's the same mentality that we're fighting with in this

K-I guess I haven't really heard too much directly, personally, but I think that most of it comes from Europe and it's groups like Greenpeace and activists groups that you hear on the new that are taking the positions that we shouldn't have GMOs and that it should be mandatory to label and I think that there are some sentiments in this country that think that labeling should be required and plain, I'm not sure how I stand on that issue

D-I guess I do with the labeling issue just because it's the boy that cried wolf, we've got so much information on a label now that 95% of the consumers don't look at it an don't care anyway and the part that does care they immediately assume that this is dangerous that this is bad no matter what that label says, the grocers are against it pretty much

W- the most direct thing that I've found is that in the last year or so especially when roundup ready beans came out that for the year or two they wanted to know everything and then it got to the point that they didn't want to know, don't tell us unless we absolutely have to ask in a given situation

D-the assumption is that if it's labeled that it is different than non-GMO crops and I'm as far as I know and as far as I'm concerned there is no difference, but I think that the chemical companies or seed companies whoever have made some mistakes in promoting this in promoting this whole thing and the producers have had reasons to accept the biotechnology because it is economic for us but the consumer really has had no incentive to accept or not accept the seed or whatever you want to call it and there are some things coming down the pipe possibly probably that will be of benefit to the consumers rather than the producers and then this fiasco with the Starlink corn has been a whole different deal and obviously I guess if the concerns are true that we should take peanuts off the market because that is the issue uh peanuts have people are allergic to those and it is the same protein that is in the Starlink corn is the only reason it hasn't been accepted as a food product so we are held to a double standard so if it's a natural product it's ok and if it's a GMO product with same potential hazard if that's what you want to call an allergy then it's not ok and the tolerances right now are zero which is unobtainable I was reading some stuff today that corn pollen can actually travel over 500 miles given the right conditions so there is no way that you could state emphatically or without error that your crop does not have any genetically modified pollen in it because it may have come from Illinois

R-I guess I'd have to argue with you about the economics of the farmer I think its done nothing but hurt our exports and I think the only one who's actually made any money on this is Monsanto.

K-Well certainly the Starlink episode hurt exports, but I'm not for sure that Roundup Ready beans have hurt exports

D-The figures in 1995 before Roundup Ready soybeans came out, now don't quote me on these numbers but it's like 18 billion in chemical herbicides were used on beans and in 1999 it's under 13 including technology fees so a total and crop acres have gone up and crop protection costs have gone down which I would see as a benefit to producers

O-What brought this on in the first place, was talking about 15 years ago they said they could detect Atrazine in rainfall which was supposed to of been pretty __?, they said they could detect Atrazine anywhere which is what has really brought on this idea...I still think they have to go through a real strict standard that they could give us a good product first and I they've proved that, but Monsanto was they're own worst enemy when they release this because they were going to sue everybody if they did this or did that that and they were making too much fuss about that and they never said anything about the good part of it
B-until they just threw this all out at once and they everybody was going Roundup ready beans and maybe if they gave everybody a choice and maybe that would of helped you know and told them that there wasn't no danger or anything like that
O-Ohh they assumed that everybody was going to go Roundup overnight and they didn't say anything about the benefits they were just afraid that somebody was going to make a dollar off of them and Monsanto was their own worse enemy

WHAT IS THE SOURCE OF MOST OF YOUR INFORMATION ABOUT GMO FOOD?

-Farm magazines
-Farm magazines and the internet
O-our problem is we get it all from the pro sides and don't get any of it from the negative sides

W-I guess news cast when they're talking about Europe and stuff every once in a while something is kicked in there, just the fact that anything agriculturally doesn't have to be strictly the crops where is seems to be most prevalent right now but some of the livestock stuff or some of the things they're doing over there that I think that we just keep on hearing things across the news in places that either adversely or proactively supports agriculture and that whatever it is it's always something big it's never something little and right now we seem to be at the forefront

DO YOU FEEL SOURCES ARE TRUSTWORTHY?

W-most the articles I've read in some of the farm magazines have given some of the negative sides, I realize that farm magazines are in support of farmers but I think they've added some good information on what the others are doing or why.. I think in today's world that everything, somebody is going to take a stand on something one way or another and it's just seems more prevalent to find out who's where

K-occasionally, I'll see an article in the Wall Street Journal or television or something like that and many times those are negative and usually I take those with a grain of salt depending on who the reporter is or who wrote the article you can usually pretty much tell from the beginning what their world view is what kind of stance they're going to take on any given issue

A-I think that 60 Minutes is hurting farmers worse than anything it always seems that they're always coming up with something negative

R-I don't think the farm publications are going to be too negative because they have a lot of advertising dollars at stake, don't bite the hand that feeds you

W-the whole problem with any publication or any news reporting agency or what ever it is, who's ever is doing it is going to follow their agenda and I think that we need to be concerned with and probably the whole problem with this mess is that we're reading these things out of farm magazines and looking at it for pro-support and the reporter in Columbus that is anything GMO or genetically enhanced and writes that I think we need to look at it from the standpoint of who is having the more affect on the masses and yeah I could read two paragraphs and be like now I'm not going to read anymore of this because I know what he or she is going to say on the activist's side now I'm one person, all of us here might have read the same article, but that people goes to a thousand people a day there might be two, three hundred people a day that read all of it and I think that that's something, on our sources yeah we can agree but on total sources,

K-In general I wouldn't trust the general media any further than I can throw them and I usually distrust them, farm media I trust maybe half the time, maybe sixty percent

B-Is it, you know really, one end's saying it's really really bad and the other one's saying there's absolutely nothing to worry about maybe it's is in the middle, just a little of both I mean nobody knows for sure

O-I've read a lot of farm that when you got done you know that this guy failed math in school

NAME POSSIBLE BENEFITS

O-The main one would be less chemical carryover and less chemical pollution

K-better nutrition for the consumer in some cases

W-a lot cheaper for us to put out

D-I'm not sure that we could count on that I think these chemical companies what their share

W-well as of right now overall it's basically cheaper

O-Well Roundup Ready beans, I'm not sure about the corn and the Bt corn, that's a question at this point

W-on the livestock thing, what's it's done and what it's going to do is it's going to take and make the animals a lot more efficient animals, I know genetically selection on dairy animals has made great strides in the last 30 yrs used to be that if somebody at a 15,000 pound milking herd that they had a real good herd now they'd be a poor herd

O-if you look at the cattle shows and the worst cow at the show would of won it 30 years ago

D-if you look at how many faces there are to feed and we farm a very small portion of this world and the more that can be produced, you know when people talk about organic crops and such, I

mean we could go back to that method of production but we would have to tear up every rain forest in South America to do it and so ideally if we could produce more, better, and quicker to using less area and less chemicals we're better off in terms of the environment and the consumer both

R-We've lost a lot of ground here to go back to natural habitat here too

NAME SOME PROBLEMS

W-the first problem I see is going too far too fast, the Roundup Ready thing's work because it was basically simple but we've got some biotechnology that's happening especially in the animal line, talk about cloning and we get to the point that we're going so far so fast that there's going to be some drawbacks that are going to be more adverse than the one step at a time

D-it's a moral issue, do you want to clone someone, but if they clone your heart that might be ok there are a lot of issues that we have to answer not only legally, but morally

W-to take it like with what I understand of Roundup Ready beans they've changed one gene they've dealt with just one gene, whereas when you're starting to cover the genetic field in one fell swoop how fast is too fast

D- however if we can take rice and insert vitamin A and save lives is that a bad thing or a good thing

K-I read a letter to the editor in one of the farm journals, that those people really need more variety in their diet, but their not going to get more variety in their diet and if all they have available is rice then it's going to be a huge benefit in those parts of the world that can't afford the other foods of greater variety it's going to be a life and death benefit to them to have that product

O-with all this scare in Europe, it's because Europe's track record in the last 50 years on food safety has been horrible because if you pay attention to the news they've had some huge disaster in Europe almost every year in the last 50 years, Olive Oil, somebody was selling contaminated olive oil and people got sick and they had all those problems in England and they still managed to send the by-products all over the rest of Europe and now they have problems all over Europe, why wasn't someone awake that day, their track record's horrible

W-I think that the worst problem that we have currently is the perception that's being yielded

K-I can think of one close to home problem for me as a farmer is that it's now illegal to save our own seed, now I can see why they've had that concern and done that so we're not brown bagging seed to our neighbor and keeping the DuPonts and Monsantos' able to have the income for developing more fo these technology down the road but I still feel that on our own farms from our own production that we should be able to save our own seed but if we do it then we're a criminal

D-I agree with that statement even to the point that I wouldn't mind paying the technology fee, I would pay a licensing fee to do that and that shouldn't be any harder to enforce than no replant at all.

K-well we can do it for any non-GMO seed

O-the Monsanto deal isn't too bad because we're getting a lot of insurance from Monsanto now the re-plant program is now worth a 100% replant and somehow Monsanto comes along and kicks you back a bunch of money, I had Monsanto give me back a bunch of money I think it only cost me about a $120 a gallon for Roundup last years plus the replant, plus I had this crop insurance that paid for the replant in the first place, so if you get it all it's not that bad a deal

WHAT QUESTIONS DO YOU HAVE ABOUT GENETICALLY MODIFIED FOOD?

D-We have a lot of the same questions that consumers have, at least I do, I'm not real sure I feel more comfortable about the GMOs than I do about the pesticides that they've replaced but still I don't feel comfortable that I'm being told everything they know and I don't think they know everything so there's for instance the RR beans we've talked about and Roundup, glyphosate itself, we're starting to see some what we think are some immunities, or resistance, and I was told personally by a Monsanto guy personally less than 2 years ago that there was no resistance to Roundup and now we're seeing magazine articles full of them so what corner are we painting ourselves into if Roundup won't work? So there is more to the issue than genetically modified

K-the question I'm hearing consumers raise that I don't have a good answer to yet is the concern about some genetically modified organisms straying elsewhere in the environment and what the evolution is of these genes out there in the gene pool or wherever they are and what the consequences of that might be down the road, I guess I'm not too personally concerned about that right now but I hear the question occasionally and I don't have an answer

D-I guess it's logical that if these same things can be done by crossbreeding than I it should logical to assume that these things can cross-breed in the wild

W-I think that anytime you have anything that comes up there are always questions and we want all the answers to all of the questions and one that's impossible, and from my standpoint, the RR beans have solved a lot of problems that I have on the farm, now I also know that Roundup is not going to be a cure all but right now it sure helps when I'm doing this and trying this I didn't go all hogwash at first I wanted to see it work and now that I've seen it work and I think that's the question mark, whatever comes next out of this ok I might try 5-10% of my acreage to make sure that it works

D-now see that's what the news media does not do, it's all or nothing, when you hear about Monarch butterflies being killed by Bt corn it's front page news, when they find out it's not a problem it's back page news

W-I guess the biggest question I have concerning GMOs is what do we need to do in order to not loose the ground that we've gained but not offend the entire world population of where we're headed

O-I want them to make sure they're safe before they ever release them
D- but that wouldn't matter
O-but that's what's caused this problem here now

K-Starlink corn was released too soon

W-I still think there is a progression to everything, we would of eventually for cross-bread RR beans the technology just escalated the speed of that happening a lot of the dairy has been genetic

selection and now we're going to get into some gene stuff and so forth just look at the hogs that now have the stress gene and now they can pin-point it, I remember a couple years ago when I got into show-sheep that they had the spider syndrome and now you can test rams to see if that's there and that's a positive thing that what was an unknown 10yrs ago is a known today and what is know now isn't going to be enough 10 years from now

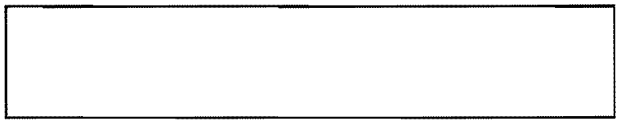
D-technology has exceeded our ability to control, we can test for such minute quantities, like with the traveling pollen contamination, detecting something at any level beep beep beep blows zero tolerance thresholds

W-so according to what you're saying my bin of corn I'm getting ready to load on a semi probably has Starlink corn in it

O-I know I've never planted Bt corn, but since Bt corn's come out I've never seen a corn borer, I've not seen any corn borer damage since Bt corn came out and I've not planted Bt corn and I've seen corn borer a lot before that though maybe we've already got it and we're just not paying for it

W-that's one bug I think extinction would be real good for

**Appendix 2: GM Foods on the Market**



Foods on the Market

## Genetically engineered crops allowed in the US food supply

**Product**

**Institution(s)**

**Engineered Trait(s)**

**Sources of New Genes**

**Name**

Canola

Monsanto

Resist glyphosate herbicide to control weeds

Arabidopsis, bacteria, virus

Roundup Ready

1999

Canola

Monsanto

Altered oil (high lauric acid) to use on soap and food products

Calif bay, turnip rape, bacteria, virus

Laurical

1995

Canola

Aventis

Resist glufosinate herbicide to control weeds

Bacteria, virus

Name unknown

2000

Chicory (radicchio)

Bejo Zaden

Male sterile to facilitate hybridization

Bacteria

Seed Link

1997

Corn

Monsanto

Bt toxin to control insect pests (European corn borer)

Bacteria

YieldGard

1995

Corn

Aventis

Resist glufosinate herbicide to control weeds/male sterile to facilitate hybridization

Bacteria, virus

SeedLink

Date unknown

Corn

Aventis

Resist glufosinate herbicide to control weeds

Bacteria, virus

LibertyLink

Date unknown

Corn

Dow/Mycogen

Bt toxin to control insect pests (European corn borer)

Corn, bacteria, virus

NatureGard

1995

Corn

Monsanto/DeKalb

Bt toxin to control insect pests (European corn borer)

Bacteria

Bt-Xtra

1997

Corn

DuPont/Pioneer Hi-Bred

Male sterile to facilitate hybridization

Potato, corn, bacteria, virus

Name unknown

1998

Corn

Monsanto

Resist glyphosate herbicide to control weeds/Bt toxin to control insect pests (European corn borer)

Arabidopsis, bacteria, virus

Name unknown

1998

Corn

Monsanto/DeKalb

Resist glufosinate herbicide to control weeds

Bacteria, virus

Name unknown

Date unknown

Corn

Aventis

Resist glufosinate herbicide to control weeds/Bt toxin to control insect pests (European corn borer)

Bacteria, virus

Star Link

1998

Corn

Monsanto

Resist glyphosate herbicide to control weeds

Arabidopsis, bacteria, virus

Roundup Ready

1998

Corn

Novartis

Bt toxin to control insect pests (European corn borer)

Bacteria

Bt11

1996

Corn

Novartis

Bt toxin to control insect pests (European corn borer)

Corn, bacteria, virus

Knock Out

1995

Corn (pop)

Novartis

Bt toxin to control insect pests (European corn borer)

Corn, bacteria, virus

Knock Out

1998

Corn (sweet)

Novartis

Bt toxin to control insect pests (European corn borer)

Bacteria

Bt11

1998

Cotton

Monsanto/Rhone-Poulenc

Resist bromoxynil herbicide to control weeds/Bt toxin to control insect pests (cotton bollworms and tobacco budworm)

Bacteria

Name unknown

1998

Cotton

Monsanto

Bt toxin to control insect pests (cotton bollworms and tobacco budworm)

Bacteria

Bollgard

1995

Cotton

Monsanto

Resist glyphosate herbicide to control weeds

Arabidopsis, bacteria, virus

Roundup Ready

1996

Cotton

DuPont

Resist sulfonylurea herbicide to control weeds

Tobacco, bacteria

Name unknown

Date unknown

Cotton

Monsanto/Rhone-Poulenc

Resist bromoxynil herbicide to control weeds

Bacteria, virus

BXN Cotton

1995

Flax

Univ Saskatchewan

Resist sulfonylurea herbicide to grow in soils with herbicide residues

Arabidopsis, bacteria

CDC Triffid

1999

Papaya

Cornell Univ/Univ Hawaii

Resist papaya ringspot virus

Bacteria, virus

Sunup, Rainbow

1997

Potato

Monsanto

Bt toxin to control insect pests (Colorado potato beetle)

Bacteria

NewLeaf

1995

Potato

Monsanto

Bt toxin to control insect pests (Colorado potato beetle)/resist potato virus Y

Bacteria, virus

NewLeaf Y

1999

Potato

Monsanto

Bt toxin to control insect pests (Colorado potato beetle)/resist potato leafroll virus

Bacteria, virus

NewLeaf Plus

1998

Soybean

DuPont

Altered oil (high oleic acid) to increase stability, reduce polyunsaturated fatty acids

Soybean, bean, bacteria, virus

Name unknown

1997

Soybean

Aventis

Resist glufosinate herbicide to control weeds

Bacteria, virus

Name unknown

1998

Soybean

Monsanto

Resist glyphosate herbicide to control weeds

Petunia, soybean, bacteria, virus

Roundup Ready

1995

Squash

Seminis Vegetable Seed

Resist watermelon mosaic 2 and zucchini yellow mosaic viruses

Bacteria, virus

Freedom II

1995

Squash

Seminis Vegetable Seed

Resist watermelon mosaic 2, zucchini yellow mosaic, cucumber mosaic viruses

Bacteria, virus

Name unknown

1997

Sugarbeet

Monsanto/Novartis

Resist glyphosate herbicide to control weeds

Bacteria, virus

Name unknown

1999

Sugarbeet

Aventis

Resist glufosinate herbicide to control weeds

Bacteria, virus

Name unknown

2000

Tomato

DNA Plant Technology

Altered ripening to enhance fresh market value

Tomato, bacteria, virus

Endless Summer

1995

Tomato

Monsanto

Altered ripening to enhance fresh market value

Bacteria

Name unknown

1995

Tomato

Zeneca/PetoSeed

Thicker skin and altered pectin to enhance processing value

Tomato, bacteria, virus

Name unknown

1995

Tomato

Monsanto/Calgene

Altered ripening to enhance fresh market value

Tomato, bacteria, virus

FlavrSavr

1994

Tomato (cherry)

Agritope

Altered ripening to enhance fresh market value

Bacteria

Name unknown

1996

**NOTES**

Regulation and product names:

1. All crops listed above required a determination from the US Department of Agriculture (USDA) that they were not plant pests under the Federal Plant Pest Act.

2. Bt crops, in addition to USDA regulation, were approved by the Environmental Protection Agency (EPA) under the Federal Insecticide, Fungicide, and Rodenticide Act and the Federal Food, Drug, and Cosmetic Act.

3. Before most of the herbicide-resistant crops could enter the food supply, EPA registered the herbicide for use on the new crop. Sulfonylurea-resistant flax is the exception because the herbicide is not to be sprayed on the crop. Sulfonylurea-resistant flax is to be planted only in soils containing sulfonylurea residues.

4. Although not required, all products were the subject of voluntary consultations with the Food and Drug Administration (FDA) about food safety. FDA required labeling of two products—canola and soybean with altered oils—because the agency considered the oils to be significantly different from nonengineered canola and soy oil. The required labels do not divulge that the oils were obtained from genetically engineered crops.

5. To the extent they are known, the chart lists trade names or company designations for crops at the time they finished the regulatory process. Once a crop is commercialized and licensed to other companies, it may be sold under many other names.

Sources: webpages of USDA at www.aphis.usda.gov/bbep/bp/index.html; EPA at www.epa.gov/oppbppd1/biopesticide; FDA at vm.cfsan.fda.gov/~lrd/biocon.html; communications with agency staff and company representatives; *Federal Register* notices and agency documents on individual crops.

Revised March 2000

UNION OF CONCERNED SCIENTISTS
2 Brattle Square
Cambridge, MA 02238
617-547-5552
Contact us at ucs@ucsusa.org